Journal and Proceedings

OF

The Royal Society of Western Australia.

PATRON: HIS MAJESTY THE KING.

Volume V.

1918 - 1919.

The Authors of Papers are alone responsible for the statements made and the opinions expressed therein.

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LIST OF OFFICERS 1918-1919.

PATRON:
His Majesty the King.

VICE-PATRON:
His Excellency The Right Hon. Sir William Ellison-Macartney, P.C., K.C.M.G.

PRESIDENT:
William J. Hancock, M.Inst.C.E., M.I.E.E., Hon. Lieut. A.A.M.C.

VICE-PRESIDENTS:
G. L. Sutton.
E. S. Simpson, D.Sc., B.E., F.C.S.

MEMBERS OF COUNCIL.
Professor W. J. Dakin, D.Sc., F.L.S., F.Z.S.
A. Gibb Maitland, F.G.S.
A. Montgomery, M.A., F.G.S.
D. D. Paton, M.A., M.B.
C. E. Lane-Poole.
Professor A. D. Ross, M.A., D.Sc., F.R.S.E., F.R.A.S.

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Mrs. C. M. G. Dakin, B.Sc.

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F. E. Allum.

HONORARY LIBRARIAN:
W. E. Shelton, B.Sc.

HONORARY AUDITORS:
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A. Knapp, B.O.A.

PAST PRESIDENTS:
1914-15—Professor W. J. Dakin, D.Sc., F.L.S., F.Z.S.
1915-16—A. Gibb Maitland, F.G.S.
1916-17—Professor A. D. Ross, M.A., D.Sc., F.R.S.E., F.R.A.S.
1917-18—A. Montgomery, M.A., F.G.S.

POSTAL ADDRESS AND PLACE OF MEETING:
The Museum,
Beaufort Street,
Perth,
Western Australia.

LIST OF MEMBERS.

Honorary Members.

Bird, Mrs. A. M., The Old Farm, Albany.
Cooke, Prof. W. E., M.A., F.R.A.S., The Observatory, Sydney, New South Wales.
French, Charles, F.L.S., F.R.H.S., Melbourne.
Forrest, Rt. Hon. Baron, G.C.M.G., P.C. (deceased, Sept., 1919).
Maiden, J. H., F.R.S., F.L.S., Government Botanist, Sydney.
Milligan, A. W., c/o Royal Australasian Ornithologists' Union, Melbourne.

Corresponding Member.

Hedley, C., F.L.S., Australian Museum, Sydney.

Ordinary Members.

Alder, Miss, 237 Beaufort Street, Perth.
Aldrich, F., Fisheries Department, Perth.
Alexander, W. B., M.A., Museum, Perth.
Allum, F. E., Royal Mint, Perth.
Allum, Miss Enid, 60 Mount Street, Perth.
Andrews, Cecil, M.A., View Street, Cottesloe.
Blackall, W. E., M.D., F.R.C.S., L.R.C.P., Leake Street, Cottesloe.
Blatchford, T., B.A., Mines Department, Perth.
Boas, I. H., B.Sc., Technical School, Perth.
Boultbee, G. F., Commercial Union Chambers, Perth.
Bowley, H., Geological Survey Department, Perth.
Browne, Maurice, M.A., B.A., Government Smelter, Ravensthorpe.
Clark, E. deC., M.A., Geological Survey Department, Perth.
Creeth, F. B., 39 Broome Street, Cottesloe.
Creeth, Miss M. E., 38 Wilson Street, Perth.
Curlewis, H. B., B.A., F.R.A.S., Observatory, Perth.
Dakin, Prof. W. J., D.Sc., F.L.S., F.Z.S., University, Perth.
Dakin, Mrs. W. J., B.Sc., Charles Street, South Perth.
Farquharson, R.A., M.A., M.Sc., F.G.S., Geological Survey Office, Perth.
Feldtmann, F. R., Geological Survey Department, Perth.
Grasby, W. Catton, F.L.S., West Australian Chambers, Perth.
Gray, H. J., M.B., B.S., 25 Richardson Street, Perth.
Hall, A. J., 7 Ruby Street, North Perth.
Hancock, W. J., M.I.C.E., M.I.E.E., Public Works Department, Perth.
Hancock, Mrs. W. J., 47 Forrest Avenue, Perth.
Herbert, D. A., B.Sc., Government Analyst's Department, Perth.
Holmes, H. D., W.A. Bank, Perth.
Honman, C. S., B.M.E., Geological Survey Department, Perth.
Johnson, Miss E., "Glen Lyn," Shenton Road, Claremont.
Johnston, Capt. F., Wyndham.
Kingsmill, Hon. W., B.A., M.L.C., 49 Outrim Street, Perth.
Knapp, A., B.O.A., Altona Street, Perth.
Lane-Poole, C. E., Forestry Department, Perth.
Lefroy, H. Maxwell, Ventnor Avenue, Perth.
Le Souef, E. A., B.V.Sc., Zoological Gardens, Perth.

List of Members—*continued.*

Lipfert, O. H., The Museum, Perth.
Lotz, H. J., F.R.C.S., D.P.H., M.R.C.S., L.R.C.P., Palace Court, Perth.
Lovegrove, F., M.B., 8 Australian General Hospital, Fremantle.
Lowe, Miss, Government Girls' School, James Street, Perth.
Lukin, Mrs., Roberts Road, Subiaco.
Maitland, A. Gibb, F.G.S., Geological Survey Department, Perth.
Maitland, Mrs. Gibb, Ventnor Avenue, Perth.
Male, A., M.L.A., King's Park Road, Perth.
McGhie, L., Department of Agriculture, Perth
McKail, H., Perth Boys' School.
McMillan, Hon. Sir Robert, Chief Justice, View Street, Cottesloe.
Montgomery, A., M.A., F.G.S., Mines Department, Perth.
Montgomery, Mrs. A., 30 Richardson Street, Perth.
Nisbet, Miss J. A., Education Department, Perth.
O'Connor, Dr. M., Weld Club, Perth.
Oldham, Hugh, Public Works Department, Perth.
Parkinson, W. C., Carnegie Institution Magnetic Observatory, Watheroo.
Paton, D. D., M.A., M.B., Ch.B., D.O., 68 St. George's Terrace, Perth.
Perry, B., Kenny Street, West Guildford.
Riley, Right Rev. C. O. L., D.D., Archbishop of Perth, 223 St. George's Terrace, Perth.
Rolland, R. A., 29 Walker Avenue, Perth.
Ross, Prof. A. D., M.A., D.Sc., F.R.S.E., F.R.A.S., University, Perth.
Ross, Mrs. A. D., B.Sc., 41 Ventnor Avenue, Perth.
Saw, W. A., Land Titles Office, Perth.
Shelton, Mrs., 20 Kershaw Street, Subiaco.
Simpson, E. S., D.Sc., B.E., F.C.S., Geological Survey Department, Perth.
Sutherland, T. G., Fremantle Trading Co., Fremantle.
Sutton, G. L., Department of Agriculture.
Shields, W. H., B.Sc., 42 Swanbourne Terrace, Cottesloe Beach.
Talbot, H. W. B., Geological Survey Department, Perth.
Taylor, W. H., 232 St. George's Terrace, Perth.
Thompson, J., B.E., M.Inst.C.E., Esplanade, Cottesloe.
Thorp, C. G., M.B., Onslow, W.A.
Tomlinson, A., M.Sc., University, Perth.
Trethowan, W., M.S., 267 St. George's Terrace, Perth.
Watkins, A. O., A.R.S.M., F.G.S., 67 Malcolm Street, Perth.
Whalley, Rev. D. T., Alberton, S.A.
Webster, Alfred, M.D., 229 St. George's Terrace, Perth.
Wood, J. A., Government School, Darkan.
Woolnough, Prof. W. G., D.Sc., University, Perth.
Zabel, Mrs. F., 621 Hay Street, Perth.

Associate Members.

Allen, F. B., M.A., B.Sc., F.L.S., Technical School, Perth.
Campbell, W. D., A.K.C., F.G.S., A.M.I.C.E., Lucknow, St. Willoughby, New South Wales.
Clark, J., 54 Jewell Street, Perth.
Cleland, J. Burton, M.D., Department of Public Health, Macquarrie Street, Sydney, New South Wales.
Creeth, Mrs. F. B., Broome Street, Cottesloe Beach.

List of Members—*continued.*

Duffy, Mrs. Gavan, 11 Heytesbury Road, Subiaco.
Gribble, Rev. E. R., Forrest River Mission, Wyndham.
Hardy, G. H., Museum, Hobart, Tas.
Lapsley, R. G., Government Analyst's Department, Perth.
Le Mesurier, C. J. R., 39 St. George's Terrace, Perth.
Lodge, Mrs., 100 Outram Street, Perth.
Norman, Mrs., Palace Court, Perth.
Paton, Mrs., 16 King's Park Road, Perth.
Pearson, H. E., B.Sc., Modern School, Perth.
Shelton, W. E., B.Sc., Modern School, Perth.
Shelton, Mrs. W. E., 116 Heytesbury Road, Subiaco.
Shelton, Miss K., 20 Kershaw Street, Subiaco.
Shugg, H. G., School of Agriculture, Narrogin.
Simpson, Mrs. E. S., "Carlingford," Mill Point, South Perth.
Steedman, H., Suburban Road, Victoria Park, Perth.
Watson, Mrs. H., "Inchbrayock," South Perth.
Watson, Miss P., "Inchbrayock," South Perth.
Wright, A. R. L., L.R.I.B.A., Public Works Department, Perth.
Wood, W. E., Existing Lines Branch, Railway Department, Perth.

Student Member.

Montgomery, S. K., 30 Richardson Street, Perth.

Total Membership.

Honorary Members	6
Corresponding Member	1
Ordinary Members	76
Associate Members	24
Student Member	1
	108

ROYAL SOCIETY OF WESTERN AUSTRALIA.

Annual Report for the Year 1918-19.

Ladies and Gentlemen—

Your Council beg to submit the annual report for the year ending 30th June, 1919.

During the year eight new members and four associate members were elected and four resigned.

A communication was received from the Royal Society of New South Wales conveying a request from the Royal Society of London that a conference of Royal Societies of Australia should be held concerning matters of interest, and inviting this Society to send delegates to a conference to be held in July at Sydney. The Council telegraphed to Mr. Maiden of the Botanic Gardens, Sydney, and Professor Cooke, of the Sydney Observatory, asking them to represent our Society and both these members agreed to represent our Society at the conference.

During the year there were eleven meetings of the Council, and the attendance of members was as follows:—Mr. Hancock 8, Mr. Sutton 8, Mr. Simpson 8, Mr. Shelton 10, Mr. Allum 10, Mr. Montgomery 7, Professor Ross 9, Professor Dakin 7, Dr. Paton 2, Mr. Lane-Poole 2, and Mrs. Dakin (secretary) 9.

We record with regret the death of Lord Forrest who was one of the honorary members of the Society.

Since the last Annual Meeting Mr. W. E. Shelton, B.Sc., has accepted the position of Librarian left vacant by the departure of Dr. Stoward for the Eastern States.

The Treasurer's Report shows a credit balance of £36 5s. 4d. on the 30th June, 1919.

The Publication Committee for the year comprised the President, Mr. W. J. Hancock, and Messrs. Montgomery, Allum, and Shelton. During the year Volumes III. and IV. have been published and issued to members.

The List of Library Exchanges has been revised and extended, and the Council hopes that this will result in many additions of value, and will be of interest to members.

There were nine General Meetings held during the year and the following papers have been given:—

1. The Physiographic Elements of the Swan Coastal Plain, by Professor W. G. Woolnough, D.Sc.
2. Causes which led to the colonisation of Western Australia, by J. S. Battye (by invitation of the Council).

3. Acclimatisation, by Hon. Walter Kingsmill, B.A.
4. Some aspects of Town Planning, by W. A. Saw.
5. Sheep Disease in Western Australia, by Professor Dakin, D.Sc.
6. Houses in Western Australia, by A. R. L. Wright, Lic. R.I.B.A.
7. *Nuytsia Floribunda* (The Christmas Tree): Its structure and parasitism, by D. A. Herbert, B.Sc.
8. Light and the Ether, by Professor Ross, D.Sc.
9. Hisingerite from Westonia, by E. S. Simpson, D.Sc.
10. President's Address on Science and Civilisation, by W. J. Hancock, M.I.C.E.

The Society had two expeditions during the year, one to Mount Henry under the leadership of Dr. E. S. Simpson, and the other to the Observatory by invitation of Mr. H. B. Curlewis, B.A.

The Annual Conversazione was held at the University on Saturday evening, 28th June, 1919.

Your Council takes this opportunity of acknowledging the courtesy of the University in allowing the Society the use of some of its rooms on different occasions throughout the year.

WILLIAM J. HANCOCK,
President.

C. M. G. DAKIN,
Hon. Secretary.

STATEMENT OF RECEIPTS AND EXPENDITURE DURING THE YEAR ENDED 30TH JUNE, 1919.

	£	s.	d.		£	s.	d.
Subscriptions	78	4	0	Printing Vol. III.	37	12	3
Interest on Banking Account ...	0	8	8	Printing Vol. IV.	22	0	0
Author's fees for extra reprints of papers	12	4	10	Lithography Vol. III.	2	2	9
				Lithography Vol. IV.	4	16	3
				Fees to Trustees of Museum ...	12	0	0
				Postage and petty expenses ...	14	19	8
Total Receipts	90	17	6	Total Expenditure ...	93	10	11
Balance in hand at beginning of year—				Balance in hand at end of year—			
At Bank ... 38 4 8				At Bank ... 35 8 6			
In Cash ... 0 14 1				In Cash ... 0 16 10			
	38	18	9		36	5	4
	£129	16	3		£129	16	3

(Signed) F. E. ALLUM,
Hon. Treasurer.

Audited and found correct—
(Signed) A. O. WATKINS.
(Signed) A. KNAPP.
5th July, 1919.

PROCEEDINGS OF THE ROYAL SOCIETY OF WESTERN AUSTRALIA.

13*th August*, 1918: Mr. G. L. Sutton, Vice-President, in the Chair. Mr. D. A. Herbert was elected a member. Professor Ross exhibited a drawing of the *Light curve of the new star in Aquila* from the beginning of June to date. Mr. Steedman exhibited a *cactus and a palm plant* and members discussed the economic value of the cactus plant. Professor Woolnough contributed a paper on *The Physiographical Elements of the Swan Coastal Plain*. Messrs. Simpson, Montgomery and Grasby took part in the discussion which followed.

10*th September*, 1918: The President, Mr. W. J. Hancock, in the Chair. The President referred to the death of Lord Forrest, and to the loss which the State of Western Australia had sustained. A message of sympathy with Lady Forrest was passed. Mr. Hugh Oldham was elected a member; Mrs. Lodge, Mrs. Gavan Duffy, and Mr. Pearson were elected associate members. Mr. J. S. Battye, on the invitation of the Council, read a paper on the *Reasons for the Establishment of the Swan River Colony*.

8*th October*, 1918: The President, Mr. W. J. Hancock, in the Chair. Mrs. Norman was elected an associate member. The Hon. W. Kingsmill gave an address on *Acclimatisation*, dealing specially with the work carried on in this State. Professor Dakin, Mr. Le-Mesurier and Professor Ross contributed to the discussion.

9*th November*, 1918: The President, Mr. W. J. Hancock, in the Chair. Mr. I. H. Boas was elected a member. Mr. W. A. Saw read a paper, illustrated by lantern slides, on *Some Aspects of Town Planning*. Mr. Allum, Miss Creeth, Professor Ross, and Mr. Shields discussed the subject of the paper.

10*th December*, 1918: The President, Mr. W. J. Hancock, in the Chair. Mr. Montgomery exhibited a specimen of the flower of the New Zealand Christmas Tree (*Metrosideros tomentosa*), the Maori name being *Pohutukawa*. The flower was the first bloom of a tree about 17 years old which had been planted in Perth in 1904. Mr. Simpson exhibited crystals of pure potassium and sodium sulphate extracted from West Australian *Jarosite*. Professor Dakin read a paper on the so-called *Beverley Sheep Disease*, giving an account of his researches on the subject up to date. Dr. Paton and Mr. Kingsmill discussed various points raised by this investigation.

11*th March*, 1919: The President, Mr. W. J. Hancock, in the Chair. Dr. H. J. Gray, Mr. H. Maxwell Lefroy and Mr. L. McGhie were elected members. Mr. Wright read a paper on *Houses in Western Australia*, illustrated by diagrams and lantern slides. A discussion ensued in which Mr. Shields, Mr. S. K. Montgomery and Mrs. Dakin took part. Mr. S. K. Montgomery exhibited specimens of a *fly of the family Asilidae* captured carrying its prey. Mr. J. Clark exhibited some specimens of *ant-nest beetles*.

8th April, 1919: The President, Mr. W. J. Hancock, in the Chair. Mr. H. J. Shugg was elected a member. Mr. D. A. Herbert read a paper on *The West Australian Christmas Tree* (*Nuytsia floribunda*), *its structure and parasitism,* in which he announced his discovery of definite suctorial organs on the roots; proving the parasitic nature of the plant. Professor Dakin, Miss Creeth, Mr. Shields, Mr. Catton Grasby, Mr. Alexander and Mr. Lane-Poole spoke in appreciation of the paper and congratulated the anthor on the discovery that he had made. Mr. Sutton exhibited specimens illustrating an unusual result in the *cross-breeding of bearded and beardless wheats,* being a case in which the character which is usually dominant appeared as recessive.

11th April, 1919: The members of the Society. on the invitation of Mr. Curlewis, visited the Observatory. Mr. Curlewis exhibited and explained the apparatus in use. The members observed the Moon and the planets Saturn and Jupiter through the large telescope.

13th May, 1919: The President, Mr. W. J. Hancock, in the Chair. Mr. G. F. Boultbee was elected a member. Professor Dakin and Mr. Sutton exhibited examples indicating the operation of Mendelism in connection with the cross-breeding of wheat. Dr. Simpson gave a short resumé of a paper which he presented on *Hisingerite.* He exhibited a specimen obtained at Westonia, and stated that it was the first time that the finding of this mineral had been recorded in this State. Mr. Alexander exhibited some specimens of three forms of *white-winged wrens* of the genus *Malurus,* viz.:—*M. leucopterus* Q. & G., from Dirk Hartog Island, *M. edouardi,* Campb., from Barrow Island, and *M. cyanotus,* Gould, from the mainland. He pointed out that the two insular forms which were both black and white had probably been derived independently from the blue and white mainland form. Professor Ross gave a resumé of a paper which he presented on *Light and the Ether.* He drew special attention to the theories of Einstein regarding the bending of a ray of light passing near to a large body such as the sun, and to the importance of the conditions provided by solar eclipses for deciding the question.

10th June, 1919: Mr. W. J. Hancock delivered his Presidential Address on *Science and Civilisation.* Mr. Sutton, Mr. Shields, and Mr. Wright spoke in appreciation of the address.

28th June, 1919: The Annual Conversazione was held. By the kind permission of the Senate this gathering took place in the Physical and Biological Departments of the University.

There was a large attendance of the members and their friends, and the following exhibits were shown:—

By Professor Dakin: (1) The development of the chick. (2) The development of the West Australian burrowing frog, (3) West Australian shells.

By Mr. S. K. Montgomery: Animals thrown up on the sea beach.

By Mr. A. Cayzer: West Australian sea-weeds.

By Mr. J. Clark: Ant-nest beetles.

By Mr. G. L. Sutton: (1) Four new varieties of wheat. (2) Cotton grown at Derby and Hamel. (3) Flax and millet from Derby.

By Mr. L. J. Newman: Destructive insects.

By Mr. W. B. Alexander: Birds peculiar to South-West Australia.

By Mr. E. de C. Clarke and Dr. Simpson: Aluminium ores from Western Australia.

By Dr. Simpson: Glass sands from the metropolitan area.

Interesting art craft exhibits were lent by *Miss Creeth, Mrs. Hancock, Mrs. Paton, Mrs. Montgomery,* and *Mr. Creeth. Mr. Shelton* also had on view a collection of medals, decorations and photographs taken from a Turkish officer in the Palestine campaign.

8th July, 1919: The Financial Statement for the year ended the 30th June, 1919, was presented and read by the Hon. Treasurer, and the Annual Report was presented and read by the Hon. Secretary. The nominations for the office-bearers for the ensuing year were announced. These coincided with the number of vacancies and the persons named were therefore declared duly elected. These names were:—

President—Mr. G. L. Sutton.

Vice-Presidents—Dr. E. S. Simpson and Mr. C. E. Lane-Poole.

Secretary—Mr. W. B. Alexander.

Treasurer—Mr. F. E. Allum.

Librarian—Mr. W. E. Shelton.

Members of Council—Professor A. D. Ross, Professor W. J. Dakin, Mr. A. Montgomery, Mr. E. de C. Clarke, and Mr. W. A. Saw.

Ex-President—Mr. W. J. Hancock.

The retiring President (Mr. Hancock) called special attention to the work which had been done for the Society by Mrs. Dakin during the three years that Mr. Alexander had been away from this State, and emphasised the indebtedness of the members to that lady for conducting the Secretarial duties for so long a time.

Mr. Alexander gave an address on the *Birds peculiar to South-West Australia*, illustrated by mounted specimens and skins. He stated that out of 178 species of birds only 13 were endemic, and of these the majority were nearly related to species found in South-East Australia. The latter had a much greater number of peculiar species and it must be regarded as the centre of origin of the remarkable avifauna of Australia. The subject was discussed by Dr. Simpson, Mr. Hancock and Mr. Saw.

LIST OF SOCIETIES, INSTITUTIONS, AND INDIVIDUALS FROM WHOM PUBLICATIONS HAVE BEEN RECEIVED.

Australia:

Royal Society of South Australia.
Royal Society of Victoria.
Royal Society of Tasmania.
Royal Society of New South Wales.
Royal Society of Queensland.
New Zealand Institute.
Commonwealth Institute of Science and Industry.
Commonwealth Bureau of Census and Statistics.
Geological Survey of Western Australia.
Geological Survey of Tasmania.
Department of Agriculture of South Australia.
Department of Agriculture of Victoria.
Department of Agriculture of New South Wales.
Linnean Society of New South Wales.
Tasmanian Field Naturalists' Club.
Victorian Field Naturalists' Club.
Botanic Gardens of New South Wales.
University of Tasmania.
Technological Museum, Sydney.
Australian Museum, Sydney.
C. Hedley, Esq., Australian Museum, Sydney.
J. H. Maiden, Esq., Botanic Gardens, Sydney.
Public Health Department, New South Wales

Asia:

Botanic Survey of India.
Department van Landbouw, Nijverheid en Handel, Buitenzorg, Java.

Europe:

Royal Colonial Institute, London.
Royal Botanic Gardens, Kew.
British Museum, London.

America:

Royal Society of Canada.
United States Department of Agriculture.
United States Geological Survey.
Smithsonian Institute.

America—continued.

Academy of Natural Sciences, Philadelphia.
American Association for International Conciliation.
University of California.
University of Nebraska.
University of Minnesota.
University of Illinois.
Missouri Botanic Gardens.
John Crerar Library, Chicago.
Lloyd Library, Cincinnati.
Cuerpo de Ingenieros de Minas del Peru, Lima.

CONSTITUTION AND RULES.

CONSTITUTION.

1. The Society shall be called THE ROYAL SOCIETY OF WESTERN AUSTRALIA.

2. The Royal Society of Western Australia is founded for the advancement of Science in all its branches.

3. The Society shall consist of members who shall be classed as follows: (1) ordinary members (who may be life members); (2) honorary members; (3) corresponding members; (4) associate members; (5) student members.

4. The Society may invite distinguished persons to become Patrons or Vice-Patrons.

RULES.

MANAGEMENT.

1. The General Management of the affairs of the Society, together with the custody of its property, shall be vested in a Council, comprising a President, two Vice-Presidents, a Treasurer, a Secretary, a Librarian, all ex-Presidents, and five other members.

2. All office-bearers and general members of Council shall be elected annually by ballot at the Annual Meeting of the Society.

3. The Council shall submit to the meeting in June each year, a list containing the names of members nominated by them for election for the ensuing session to the respective offices of President, Vice-Presidents, Secretary, Treasurer and Librarian. The meeting shall then proceed to nominate members for election as general members of the Council, and may nominate further candidates for offices. Additional nominations, if duly seconded, may be lodged with the Secretary within seven days after the June meeting.

4. If the number of nominations for each position does not exceed the number of vacancies, the Chairman at the Annual Meeting shall declare the persons whose names appear on the list duly elected. If the number of nominations for any office exceeds the number of vacancies a ballot shall be taken. A ballot-paper containing the names of all persons thus nominated shall be posted to members at least 14 days prior to the day of the Annual Meeting. Members shall hand in their ballot-papers, duly filled up but unsigned, to the Secretary at the Annual Meeting, or post them to him so as to be received not later than the commencement of the Meeting. Scrutineers shall be appointed at the meeting and shall announce thereto the result of the ballot.

5. Any vacancies occurring amongst the office bearers or Council during the year shall be filled up by the Council.

MEMBERS.

6. Every candidate for admission as an ordinary or associate member of the Society shall be proposed and recommended by three or more members of the Society, who shall, at a General Meeting of the Society, cause to be delivered to the Secretary a nomination form, signed by themselves, signifying the name, description and usual place of residence of such person, who must be known personally to at least one of the recommending members.

7 Every nomination form having been read at one of the General Meetings, shall be posted in some common room of the Society, and the person thus recommended shall be balloted for at the next General Meeting, after such reading.

8. No person shall be declared duly elected unless three-fourths of the number of members balloting shall vote in his favour.

9. Persons so elected shall have immediate notice thereof transmitted to them by the Secretary, accompanied by a copy of the Rules.

10. No candidate shall be deemed a member until his subscription for the current year be paid or the annual payments be compounded for. If any person elected as a member shall omit to pay the subscription (or composition in lieu thereof) within six months after the day of election, the Council shall have authority to declare such election void. Associate members wishing to become ordinary members, or *vice versa*, must obtain the consent of the Council.

11. The annual subscriptions of the various classes of members shall be as follows:—

Ordinary members—One guinea.
Associate members—Half-a-guinea.
Student members—Five shillings.

and the composition fee for life membership £15 15s.

12. The annual subscription becomes due on the 1st July in every year, in advance, and is recoverable as debt due from the member to the Society. If any member shall be in arrears of his annual contribution for two years on the day of any Annual Meeting, he shall be apprised by letter that unless the amount due by him be paid before the end of the current year his name will be removed from the list of members.

12A. All members elected at any time during the latter six months of the Financial Year shall pay half the annual subscription appertaining to the class to which each is elected for the then current year.

WITHDRAWAL AND REMOVAL OF MEMBERS.

13. No member shall be at liberty to withdraw from the Society without previously giving notice in writing to the Secretary

of his intention to withdraw, and returning all books and other property of the Society in his possession. Retiring members shall be liable for payment of all subscriptions due to the Society.

14. The Council may, by a majority of seven of its members, remove or suspend any member of the Society, with or without assigning reasons for such action. But a member whose name has been removed from the Roll shall have a right of appeal to the Society. Notice of such appeal to the Society shall be sent by such member to the Secretary within four weeks of the removal of his name, and the appeal shall be considered by the Society at the next General or Special Meeting, a majority of votes recorded at such meeting sufficing to confirm or annul the decision of the Council.

PRIVILEGES OF MEMBERS.

15. Ordinary members have the right to be present and to vote at all General Meetings; to be eligible for election to a seat on the Council; to be entitled to receive the publications of the Society; to propose candidates for admission as ordinary and associate members, and subject to the approval of the Librarian, to borrow any books, papers, manuscript, etc., belonging to the Society.

16. Ordinary members may introduce one visitor at any meeting, provided such visitor is not introduced at more than three meetings in one year.

ASSOCIATE AND STUDENT MEMBERS.

17. Associate members shall have all the privileges of ordinary members, with the exception that they shall not have the right of voting, nor of eligibility for office, nor of proposing new members.

18. Student members shall be persons attending recognised science classes in Western Australia, who shall, on application to the Council, be elected by them. They shall be elected for the calendar year. Student members shall not be entitled to any privileges, except that of attending the Meetings of the Society.

HONORARY MEMBERS.

19. The honorary members of the Society shall be distinguished workers in science or zealous patrons thereof, and shall not exceed 25 in number.

20. Every person proposed as an honorary member shall be recommended by Council, and be elected and removed in the like form and manner, and be subject to the same rules and restrictions as ordinary members. He shall be entitled to all the privileges of membership except voting.

CORRESPONDING MEMBERS.

21. The Corresponding members of the Society shall be constituted of such persons not resident in Western Australia as may

show a willingness to promote the objects of the Society, and shall be recommended and elected and be liable to be removed in like form and manner as ordinary members. The corresponding members shall be exempt from paying any subscription.

22. In case of corresponding members taking up their residence in Western Australia, their privileges shall cease at the end of the current financial year. Provided that the corresponding member shall have the privilege of becoming an ordinary member without ballot on paying subscription or composition fee.

23. The corresponding members of the Society are required to keep the Secretary informed of their addresses, or of that of some agent in Western Australia, through whom communications may reach them.

PRESIDENT AND VICE-PRESIDENTS.

24. The business of the President shall be to preside at all meetings of the Society and Council, and regulate all the proceedings therein; and generally to execute or see to the execution of the Rules and Orders of the Society. In the case of an equality of votes the President shall have a casting vote.

25. In case of the absence of the President from any of the meetings of the Society or Council, his place shall be filled by one of the Vice-Presidents, or, in their absence, by a member of the Council then present, who shall, for the time being, have all the authority, privileges and power of the President. If no member of Council should be present at a General Meeting no business shall be transacted.

TREASURER AND ACCOUNTS.

26. The Treasurer shall demand and receive for the use of the Society all moneys due or payable to the Society, and shall disburse all sums due by the Society, and shall keep full and particular account of all sums so received and disbursed.

27. All moneys received on the Society's behalf shall be paid into an account in the name of the Society in a Bank approved by the Council.

28. No moneys shall be drawn out of the said account except by cheque signed by the Treasurer, Secretary, and President, or any two of them, and all payments must first be authorised by the Council.

29. The accounts shall be made up at the end of every financial year, June 30, and be audited in the month of July by a committee of two, to be appointed at the Ordinary Meeting in June.

30. The Auditors shall have the power of calling for a statement of the debts, credits and assets of the Society, and for any information relative thereto.

31. The Committee of Auditors shall make their report to the Society at the Annual Meeting.

SECRETARY.

32. The Secretary shall perform the following duties:—

(1) Conduct the correspondence of the Society and Council.

(2) Attend all meetings of the Society, and take minutes of the proceedings of such meetings. He shall also summon such meetings.

(3) Read aloud at the commencement of meetings of Council and Society the minutes of the previous meeting; read the nominations of candidates for admission to the Society; and read the lists of donations made to the Society.

(4) Keep a list of the attendances of the members of Council at Council meetings, in order that the same may be laid before the Society at the Annual Meeting.

COUNCIL.

33. The Council shall meet at such times as shall be appointed by the President, or, in his absence, by one of the Vice-Presidents, or Secretary, due and sufficient notice being previously sent to every member.

34. No business shall be transacted in Council unless there be four or more members present. Should any member fail to attend three consecutive Council meetings without satisfactory reason being given, his position shall be declared vacant.

35. The Council shall present and cause to be read to the Annual Meeting a report on the general concerns of the Society for the preceding year, and such report shall be printed and transmitted to the members.

ORDINARY MEETINGS.

36. The Council may institute and enforce any by-laws necessary for the government of the Society, provided that such are not at variance with these Rules.

37. The General Meetings of the Society shall take place at 8 p.m. on the second Tuesday in every month during the last ten months of every calendar year unless the Council determine otherwise. Special meetings of the Society may be called by the Council whenever it may deem such expedient, or on the requisition of ten members, in writing, and specifying the purpose for which the meeting is required sent to the Secretary, who shall thereupon call a meeting within not less than seven days nor more than twenty-eight days.

38. The ordinary course of proceedings at the General Meetings after the Chair has been taken, shall be as follows:—

(1) The minutes of the proceedings of the previous meeting.

(2) Correspondence.

(3) Communications from Council.
(4) Nominations for membership and election of members.
(5) Donations to be laid on the table and acknowledged.
(6) Any other formal or general business to be dealt with.
(7) Papers and exhibits.
(8) Discussions on the various papers and exhibits which have been brought before the meeting.

39. At the General Meetings of the Society nothing relating to the regulations or management shall be brought forward, unless the same shall have been announced in the notice calling the meeting or be otherwise provided for in these Rules.

ANNUAL MEETING.

40. The Annual Meeting shall be the first meeting held in any financial year. The course of proceedings after the Chair has been taken shall be as follows:—

(1) Reading of the Minutes of the previous Annual Meeting.
(2) Reading of Nominations of Candidates for Council, appointment of Scrutineers, and opening of ballot.
(3) Presentation and discussion of the Auditors' Report.
(4) Presentation and discussion of the Council's Annual Report.
(5) Report of the Scrutineers on the result of the ballot.
(6) Address of Retiring President.

41. At the Annual or any General Meeting seven members shall constitute a quorum.

CONTRIBUTIONS TO THE SOCIETY.

42. Every paper intended to be read before the Society, of whatever character, must be sent to the Honorary Secretary at least seven days before the date of the next ensuing Council meeting, to be laid before the Council. It will be the duty of the Council to decide whether such contribution shall be accepted, and whether it shall be read in full, in abstract, or taken as read. The Council may obtain an opinion as to the suitability of any paper from any person it may select for the purpose.

43. A Publication Committee, appointed by the Council, shall decide whether a paper presented to the Society shall be published in the Proceedings.

44. The original copy of every paper communicated to the Society, with its illustrations, shall become the property of the Society, unless stipulation be made to the contrary, and authors shall not be at liberty to publish their communicated papers elsewhere, prior to their appearance in the publications of the Society, unless permission be given by the Council for so doing.

THE JOURNAL

OF

THE ROYAL SOCIETY

OF

WESTERN AUSTRALIA.

VOL. V.

Presidential Address.

By WILLIAM J. HANCOCK, M.Inst.C.E., M.I.E.E.

(*Delivered 10th June*, 1919.)

Ladies and Gentlemen—

On my retirement from the position of President of the Society, I wish to state how highly I have appreciated the honour which you conferred on me, and I take this opportunity of thanking the members of Council, officers and members, for their kindness and consideration in helping me to carry on the work of the Society. We are greatly indebted to those members who have presented papers during the season. The papers have been of not only great interest but of wider range than heretofore, and I feel sure it is a step in the right direction. I cannot but think that all matters affecting the general welfare and betterment of the conditions of life come within the scope and functions of our Society equally with matters of scientific interest, whether they be subjects of historic interest to guide us, research work of the present, or problems of the future, to consider. The field of the Society is wide, and extending with the progress of science and knowledge.

The papers presented to the Society this year have been of a varied character. The first this session was by Professor Woolnough on the "Physiographic Elements of the Swan Coastal

Plain," a paper throwing light on the geological history of this portion of the State.

Mr. J. S. Battye's paper on "Causes which led to the Colonisation of Western Australia" was a valuable contribution to the history of our State, and brought before us the need of some organisation to save from oblivion many of the interesting documents, sketches, photographs and data concerning the early settlement of the Colony. As the number of the early settlers is rapidly decreasing, efforts should be made to collect and sort out historic data before it is too late.

Mr. W. Kingsmill brought before the Society the subject of "Acclimatisation" and the very interesting work which has been carried out under his directions. This work is not only of great interest but is also of economic value to the State, and it is to be regretted that it is so little known or appreciated by the public.

"Some aspects of Town Planning" was the subject of a paper by Mr. W. A. Saw, a subject which is slowly but surely being realised as an important factor in our lives. The improvement in environment must increase the health and happiness of the community, and minimise the production of the criminal element. In the building up of our towns and cities we all realise the necessity to prevent the growth of slum conditions.

Professor Dakin's paper on his investigations into a serious form of sheep disease dealt with a subject of considerable importance and economic value to the State.

A paper by Mr. A. R. L. Wright on "Houses in Western Australia" dealt with a subject which is of general interest. The climate and other conditions naturally must affect the design and arrangements of our homes.

One of the most interesting papers read during the session was presented by Mr. D. A. Herbert on the "*Nuytsia floribunda*, its structure and its parasitism," in which he pointed out its parasitical functions, and at last cleared up the mystery which has surrounded this well known tree for so many years.

The last paper of the session was read by Professor Ross on "Light and the Ether" in which he explained the interesting theory recently advanced which threw doubt on the usually accepted theory that a ray of light travels through the ether of space in a straight line, and the especial interest in this year's Solar Eclipse, in the attempt of astronomers to answer this question.

I think the Society may be congratulated on this list of papers, and I trust that in the future we may have many papers of a similar nature affecting this land of ours, which is rich in rare and interesting subjects. No time should be lost in collecting data, as much of the fauna and flora is rapidly disappearing before what we are pleased to call civilisation.

The natural history of Australia stands out unique from other parts of the world. The evolution which has produced so many changes in other lands appears in this Island Continent to have almost stood still or moved but slowly. This may be due to its separation from Asia before the Carnivora appeared there. Indeed, the extraordinarily slow development in Australia points to what an immensely important factor Carnivora must have been in the great struggle for existence and survival of the fittest in the great process of evolution.

While the mammals of other lands are absent in Australia, the earliest forms of vertebrate mammals in the fossil beds of Europe are represented by the marsupial Kangaroo of to-day. Many of the Birds, Fishes, and Crustacea of Australia living at the present time have long ceased to exist in other parts of the world. In the Vegetable Kingdom, also, plants of the long past Carboniferous age are still represented in living form in Australia, whilst our aboriginal men do not appear to have evolved very far from their Stone-age ancestors. I have alluded to these conditions so as to indicate how wide and unique is our field of natural history, to raise our interest and enthusiasm, to advocate study and record, for it is one of the functions of our Society to stimulate and assist research in this wonderland of nature.

SCIENCE AND CIVILISATION.

I feel that at the termination of the Great War it will be opportune to bring before you, for your consideration, a few points in connection with science and its relation to progress and civilisation.

In referring to the events of last year it is impossible to think of any work or progress which has not been connected with or affected by the Great War. Each of my predecessors took for his Presidential address some of the educational or industrial problems which could be expected to arise after such a struggle, and now that the war is practically over, the problems of Peace are found to be more serious and more complex than those of the War.

The termination of the War has come perhaps more completely and more suddenly than was anticipated. It could hardly have been expected that the German Navy would surrender without a fight, and be interned in a British harbour, and that the Allies would so soon be in occupation of the cities of the Rhine.

As the War involved a greater number and variety of nations than any previous war, so the problems of Peace must affect every country of the world, for the spread of international commerce, with the rapid means of communication by railway, steamer, post and telegraphs, make any treaty or agreement between nations a matter of world-wide consequence.

We have to go back to the Wars of Napoleon to witness the breaking up of Empires and the creation of new States on anything like the scale of last year. The Prussian victory over the French in 1870-1 consummated the federation of the separate German States into one German Empire, and the defeat of the Germans last year broke up that Empire into separate States again. I think there is little doubt that the separate German States, possessing common interests, language and ideals, will coalesce, probably with the addition of Austria, into a United States of Germany, and if this is the right view it should make us all the more careful to look at our own position, to see that we do not lag behind in the march of Progress in Peace and War.

We cannot build any hope that the War of 1914 will alter human ideas or change mankind, nor that the late war will be the last one; we can only hope to postpone such a calamity as long as possible.

The change of the various types of Government in Europe into more Democratic and Socialistic forms, whether they prove permanent or not, must have an influence on our own National organisation and that of our allies. The War has shown many weak spots in our social organisation, and every citizen who has the welfare of his country at heart should study the matter so as to ascertain the causes and remedies and assist in carrying out urgently necessary reforms for the advancement, welfare, and happiness of the people.

Democracy is the equality of the educated and uneducated, and the good and bad alike, and as all modern systems of government must ultimately come to the collective vote of the individual, Right, Justice, and Freedom will depend on the intelligence and judgment of the individual and everything that can elevate the mind and body will advance the State to these ideals, and the only means to attain these ends is a sound education not of the few but of the many, for by knowledge the Nation gains power while the uneducated is a danger to himself and a menace to the community.

Europe will always be the dominating factor in Peace and War, and it is to Europe we must look for the settlement of problems between the Nations. Europe is by far the most complex of all the great divisions of the Earth, with about fifteen different languages, innumerable and increasing types and forms of religion, without any prospect of assimilation or agreement, and systems of government and politics still more numerous and unstable. Surely we see in these more than enough elements for misunderstanding and trouble, but when we go outside Europe we are faced with further problems in the various forms of language, religion, and politics. With all these perplexing differences we naturally look for some factor common to all nations, by which a

structure of Justice and Freedom can be built up, and of all the factors in human affairs Science is the only one which is universal and common to them all; it cannot be altered by language, religion, or politics, although it has often been crippled by each.

As to Australia, her isolated position from all other continents resulted in a unique and slower course of evolution in her flora and fauna, and politically she also differs from other continents in having practically one race of people, one language, and the oceans as her frontiers: she can thus develop her destiny untrammelled by the many complex problems and close competition of other nations separated, as in Europe, by a five-wire fence, a river, or a narrow strip of neutral ground.

Many bold and just experiments in social and industrial organisations have originated in Australia, but the question whether the absence of the stimulus of close contact with the ideas and progress of other countries will be an advantage or otherwise time alone will answer.

In the Great War, science has been used to the utmost extent by all the participants, and now with the prospect of Peace, surely science will be called upon to assist more than it has ever been before, in the work of reconstruction of national life and industry. We cannot go backward, nor can many of the unhappy and unjust conditions of living be allowed to continue. If the conditions of human affairs be made better as the result of the War, the sacrifices involved will not have been in vain.

I refer to science in its widest sense, as the correlation of knowledge, for to know a truth in relation to another truth is to know it scientifically.

It would be impossible in a short address to do more than take a hurried glance at the history of scientific thought which has attracted mankind from the earliest ages, and realise how it has been encouraged and suppressed at various periods of history.

Of all the sciences, astronomy has always appealed to mankind and has been studied from the earliest times. From time immemorial the recurring alternation of day and night and the seasons have appealed to men's thoughts, and attempts have been made to understand and explain these workings of nature. Phenomena of non-recurring or isolated events, such as thunderstorms or earthquakes, have generally in the past, and I fear sometimes in the present day, been attributed to what is called the supernatural, which I presume meant that there was no explanation available. The motions of the Heavenly bodies were observed and studied in ancient times by the Chaldeans, Chinese, Arabs, Egyptians, and Greeks, and it is from the Chaldeans and Arabs that many of the names used in astronomy are derived, but it is to the Greeks that great advances in astronomy and other sciences

are due, and if the Greek astronomers had possessed the telescope and the pendulum, they would probably have brought this science to a point not actually reached till the time of Sir Isaac Newton.

When we think of the theories and attempts to explain natural occurrences without the instruments of precision or the vast accumulation of scientific data which we now possess, we can only express admiration for thoughts and theories of ancient inquirers. I might allude to the very interesting and ingenious explanation made by the ancient Egyptians of the alternation of day and night. It was assumed that the earth, presumably flat, was covered by a great dome or arch, and day was caused by the sun travelling along the inner side of the dome from sunrise to sunset; while from sunset to sunrise the sun on its return journey crossed the outside of the dome, where it was hidden from the earth, and the stars were but holes in the dome through which the sunlight could be seen. This primary idea was not accepted by the Greek astronomers, as the theory of Hipparchus and Ptolemy (about 160 B.C.) assumed that the sun and other bodies revolved round the earth as a centre. This explanation gave way to the theory propounded by Copernicus about 1500 A.D., which is the theory now accepted by science.

So with other sciences the great doctrine of the conservation of energy and matter has become one of the basic principles of physics and chemistry, and the latter science has made extraordinary advances during the last few decades, and was one of the most important factors in the War, and made use of by both sides. The newer science of biology is scarcely less important, and has revealed some of the most beautiful operations in nature. For instance, for long it was thought that trees and plants derived the material for their structure from the soil on which they grew, until the biologist showed that about 95 per cent. of the tree is derived, not from the soil but from the air and water, through the agency of sunlight acting on that wonderful material chlorophyll, the green substance of the leaves separating the carbon from the carbonic acid gas in the air and the hydrogen from the water, and these two elements combining to form the wood structure and returning the oxygen to the air, a process which is reversed when we burn up the timber. The sister science of bacteriology has shown how great is the part played by bacteria both for good and evil from a human point of view.

The ruins of the great empires of Babylonia and Assyria testify to the ability of the engineers and builders. Also Persia, India, China, and Egypt can show that works of great magnitude were achieved which would even in modern times be considered formidable, with all our appliances and resources. Indeed, these ruins show the careful thought and accurate scientific knowledge that were brought to bear on these ancient works.

It is curious to note that most of the mighty nations of antiquity began and flourished in more or less rainless regions, and thus made the study of hydraulics a necessity, and engineering science was directed to water conservation and irrigation, and the remains of these works show what a high degree of efficieney had been attained.

In the ancient world, science reached her greatest height when Greece was at the zenith of her renown; and her temples, monuments and works stand out for all time as a tribute to her greatness in science and art, and to her philosophy and freedom of thought.

Rome never rose to the same high position in science and philosophy as her elder rival, Athens. Indeed, Rome was, perhaps, more utilitarian; the great works of the Roman engineers and architects stand to-day, monuments to their ability and skill. Of this classic period I might mention a few of the great thinkers and workers in science such as Euclid, Hipparchus, Ptolemy, Archimedes, Hero, and Democritus, names which prove that the prosperity and renown of any nation are intimately associated with scientific knowledge and its application.

With the rise of Christianity and the descent of the Northern Barbarians upon Rome and Greece, civilisation and science suffered an eclipse—and over Europe spread a dense pall of scientific ignorance during the dark ages from the 4th century, when Hypatia, a celebrated woman philosopher and mathematician, was murdered by a fanatic mob at Alexandria—to the time of Galileo in the 17th century. But even in the darkest hour science never lacked its devotees, and the sacred torch of science was kept alight by the great Califs of Bagdad and other cities of Arabia, who encouraged science and especially astronomy. The old Greek works were translated into Arabic, and the Arabian astronomers carried on the work and made many advances during the centuries of intellectual darkness in Europe.

Galileo is famous not only for being one of the earliest to use the telescope, and for his experiments in dynamics, but also because his teaching of the doctrine of Copernicus that the earth revolved round the sun brought him under the ban of the Inquisition, which forced him, in 1633, to abjure the Copernican theory, and thus brought about the first clear-cut conflict between science and the powers of the dark ages.

When we look back at the dark ages, that long period of 1,400 years when scientific thought and experiments were banned as impious and evil, we must realise that but for this period of stagnation and oppression science and civilisation would have advanced vastly beyond the position we occupy to-day. With the progress of scientific knowledge and thought up to the first few centuries Anno Domini, many of the great inventions of modern

times might well have been made a thousand years ago. The ancient world, especially Greece, was close on the threshold of great discoveries.

The steam engine, which is, I think, the most important invention in the history of mankind and one of the greatest factors in civilisation, was created and operated by Hero, a Greek engineer of Alexandria as far back as 150 B.C.

This engine, called by Hero the "Aeolipile" was of a primitive rotary type, in which the pressure of steam was maintained in the boiler, and the steam, escaping under pressure from jets, caused the engine to rotate.

Hero also described his air and water pumps with cylinders and pistons, and it was not until the lapse of eighteen centuries that the steam engine with cylinders and pistons was designed by Papin and others, and steadily developed into the steam engine of to-day.

The name Electricity is derived from "Elektron," the Greek name for Amber—a material which, when rubbed, attracts small particles of straw, paper, etc.

Thales of Militus, 600 B.C., is credited with having pointed out this property of Amber, but there does not appear to be any record of further knowledge on the subject until the 16th century, when Gilbert published a work on Magnetism and Electricity.

The printing press was known to the Chinese many centuries ago, but not until the 16th century was it re-invented in Europe.

I think we may fairly assume that but for the dark ages railways, steamers, electric machinery and appliances might have been invented a thousand years instead of about one hundred years ago.

It is hard to realise what our present conditions would be if the sciences of astronomy, chemistry, engineering and biology and political economy and social conditions had ten centuries of knowledge and experience behind them. Indeed we have lost a thousand years of progress.

When we look back on the ruins and wrecks of the civilisations of Babylonia, Egypt, Greece, and Rome, we may well ask "Is our own civilisation and science secure from similar annihilation?"

During the last hundred years the teaching of science has advanced perhaps more than in any other period of history and it has become world-wide. The same laws and facts are taught in the class rooms and laboratories in every University throughout Europe, Asia, Africa, America, and Australia. The starry heavens, the seas and mountains, the trees and flowers—sublime works of nature—are common to all mankind, and the study of these forms the language and thoughts of science.

There are two main factors which science teaches: one, that we must always be prepared to review our theories and doctrines in the light of new discoveries and new data, for there is no finality to scientific knowledge. The scientific beliefs of one generation have frequently been abandoned by succeeding generations, because their observation and data have been based on the apparent and from insufficient knowledge has failed to point the real factors. Lack of observation instruments prevented early investigators from analysing and proving their theories, and even in the present day doubt has been thrown on the existing assumption that light travels through space in a straight line uneffected by gravitation as of the sun, and it is expected that the solar eclipse of last month will decide this question.

We are liable to come to wrong conclusions if we only observe an occurrence from one point of view. How often do we notice when travelling fast in a railway carriage that the sparks from the engine appear to rush past; in a nearly horizontal streak it is hard to realise that the appearance of the fiery track is due entirely to our rushing past the slowly falling sparks, whereas a person watching the passing train would notice that the sparks are slowly falling vertically to the ground. This simple illustration should teach us to consider both sides of the story before we come to a conclusion.

Science teaches us that the more we know the more there is to learn, and every new discovery opens a field for further investigation. If I may be permitted to use a simile, take two circles, one small and the other large, and take the area of each circle to represent the extent of knowledge in each case and let the circumference be called the horizon of ignorance, and you will see that as the area of knowledge increases so does the horizon of ignorance increase.

Adam Gowan White, says of knowledge: "Truth is nothing more than the essence of organised knowledge." This expression grows and alters as knowledge grows and alters; it is dynamic, not static.

I have rapidly and in a very fragmentary manner referred to some of the phases in the history of science and its influence on civilisation, but with such a vast subject it is impossible to deal with it adequately in one evening.

There are one or two modern phases, however, to which I would like to allude. For some years before the War, Germany was recognised as one of the foremost, if not the foremost, nation in the encouragement of science and in the employment of scientific works in her industries.

Her scientific workers had gained for her practically a world-wide monopoly, especially in aniline dyes and also in many other chemical industries, and this was largely due to their research

—thorough and systematic research. I think the War has made it clear to us that any manufacturer who does not utilise a highly qualified scientific staff has no chance against the manufacturer who does.

We have frequently heard the statement that science made Germany brutal. With this I do not agree. It might be true to say that Germany made science brutal, or rather that she used science in a brutal manner; but war in itself is brutal.

The difference between British and German science is that Germany has built successfully by systematically collecting and co-ordinating the scientific data and investigation of her own and other countries. Information of inventions and industries is more easily obtained from German publications than elsewhere. But British scientists have always led the way in scientific philosophy and great inventions. British science is built more on initiation, whereas German science is more encyclopædic.

No country can compare with Great Britain in the record of famous men of science, and there is no branch of science wherein British scientists do not hold a first place. In support I may remind you of a few names such as Bacon, Newton, Gilbert, Napier, Dalton, Harvey, Watt, Davey, Faraday, Joule, Young, Stevenson, Brunel, Tyndal, Maxwell, Huxley, Darwin, Lister, Herschell, Crooks and Kelvin.

Coming to Australia, the value of scientific training is slowly but surely being recognised as a necessary factor in our national life if we are to hold our place in the world. The Federal Government has realised the importance of this matter by establishing an advisory council of science and industry, and I hope the Government support will be continued.

Our Education Department has also realised the economic value of scientific teaching and has introduced the system into many of the State schools, and the Department is to be congratulated on its work. Science, however, requires a sound general education as a basis, and I feel sure the time has arrived when the maximum compulsory age of school attendance should be raised from 14 to 16 years. A girl or boy is ill equipped to start life at the immature age of 14; indeed, under modern conditions, and when we realise the great increase of general knowledge during the last 50 years that the standard of education has automatically and irresistibly advanced, it will be admitted that such a child is distinctly handicapped in starting life compared with those who have been able to continue their education to a later age.

The educational value of the teaching of science in the schools was recognised some years ago in Great Britain, the three main subjects being physics, chemistry, and biology.

Physics is always an attractive subject to a boy. It explains natural phenomena and machines in which a boy is interested and with which he is familiar, especially as there are so many experiments in physics which are simple and convincing and which can be performed by a boy in his spare time. As a certain amount of mathematics is required in physics, such experiments offer a practical confirmation of many mathematical problems, which is also an advantage to the student.

Chemistry has suffered more in the past than any other branch of science. In elementary teaching its educational possibilities have been greatly underrated. Elementary chemistry demonstrates to the boy as he proceeds from a simple example, revealing the nature of the chemical changes, and proving step by step in the process, so that the student gains a sound idea of a logical and ordered argument. Chemistry demonstrates this factor better perhaps than any other science.

Biology also possesses a high educational value, as it trains the power of observation. Although many of the processes are complex and difficult to follow in the early stages, their study is calculated to make a boy take a greater interest in life.

Surely the teaching, at the impressionable school age, of the truths and logical conclusions of science must be for good and must be beneficial to the youth, for a sound training and judgment are two essentials in whatever path of life he follows.

The modern schools and continuation classes which are designed to encourage education beyond the statutory age are a great advance. Great Britain during the War raised the age of compulsory attendance at schools under certain conditions from 14 to 16, so that Western Australia has a lead to follow.

The Public Service is sadly behind in these matters. Under the Public Service regulations the age of 14 is accepted, in that a boy of this age can apply for entry to the Service, and if he passes the qualifying examination (G) at this age he can be appointed temporarily as a messenger. When he attains the age of 16 he is appointed as a junior officer, and before 18 years he has to pass a second examination, known as the "F" examination, which is more or less a test of his official attainments. His way is then clear without further educational tests to the highest appointment in the Service. As there are always many applicants from 14 to 16 years of age and as priority counts, students of the University or secondary schools are practically barred from entering the Public Service. This system is a contrast with that of the Professional division, where high educational and technical experience are necessary qualifications. No doubt with the advent of the Uni-

versity and secondary schools the regulations will be modified in due course, and the sooner the better so as to meet new conditions.

Any discussion in connection with education would be incomplete without a reference to our University, which was founded by Act of Parliament in 1911, and the first lectures began on 31st March, 1913.

Before considering our own University it might be interesting to go back to the 12th century and notice the difference in the origin and development of the medieval Italian and French Universities. The early Italian Universities started as a guild of students desirous of increasing their own knowledge, who combined and contributed to the salary of the lecturers, and also provided suitable accommodation. On the other hand the French Universities, such as that of Paris, originated from a Society of Masters: men well versed in Arts and Literature, who combined to give a course of instruction, and provided the necessary accommodation and charged fees to those students attending the classes. All the older European Universities followed one or other of these systems, and as the Universities grew in power and influence they were frequently the subject of great pressure from the Government and from the Ecclesiastical bodies, and in some instances Universities were started in opposition.

Both these systems have undergone modifications from time to time. All the older English and Scottish Universities show distinct traces of their original prototype. Oxford and Cambridge belong to the French or "Master" University type, while the Scottish Universities clearly show their Italian or "Student" University origin.

Many Universities have been founded by private individuals but in almost every instance tuition fees are charged by the University, irrespective of its origin.

The University of Western Australia differs, in that it was founded and is financed by the State, and no tuition fees are charged. Although fees are charged at other Universities it does not follow that the student himself has to bear the cost. There are numerous instances of public-spirited persons who have provided the money for the payment of University fees. The Carnegie trust is a notable instance where the fees of a large number of students who attend the Scottish Universities are paid. When the student has completed his course and has started his subsequent career, he is expected to repay to the Trust the amount of the fees paid for his tuition.

The whole tendency of the present day is to remove every obstacle from the path of the student seeking knowledge at the centre of learning.

The preamble of the University of Western Australia Act states:—

> And whereas it is desirable that provision should be made for further instruction in those practical arts and liberal studies which are needed to advance the prosperity and welfare of the people:
>
> And whereas it is desirable that special encouragement and assistance should be afforded those who may be hindered in the acquisition of sound knowledge and useful learning by lack of opportunity or means:
>
> And whereas for these purposes it is expedient to incorporate and endow a University within the State of Western Australia.

Provision is made by the Act for payment of £13,500 per annum.

The enrolments for the first year (1913) numbered 184, and since then the number of students has more than doubled. The number of students is as follows:—

Year.	Number of Students enrolled.
1913	184
1914	182
1915	214
1916	214
1917	236
1918	270
1919	400

This involves an increase in the accommodation and in the Teaching Staff, so that an increase in the annual grant is urgently required. It is a matter of disappointment that, with the exception of Sir Winthrop Hackett, nothing in the way of an endowment has been made to the University. No doubt when the real value of the institution is better understood and appreciated the University will have many more friends and supporters.

There are many persons who do not approve of a free University, and it is said that students do not appreciate learning if it is free. I do not agree with this view. I cannot believe that students do not appreciate the teaching and personal care given by the Teaching Staff, nor that graduates think less of their degrees because the State provided the facilities for obtaining them. No doubt there are students who join without any intention of continuing and who will drop out during the terms, and such students hinder others of more serious intent. To charge fees to all students simply in order to offer some obstacle to those who have no intention of studying would be hardly just to genuine students.

This State is trying the new experiment of a free University, which is a great step forward in education, but with only six years of existence, four and a half of which were under more or less war conditions, I feel that the time is too short to say that the experiment has proved a failure. I am sure it would be a retrograde step to return to the old system of charging fees for tuition.

One of the difficulties of any change or improvement in an educational system is the long time which must elapse before the real effects of a change can be understood or realised. Certainly it cannot be less than 20 years; not until the students of to-day have become factors in the life and development of the State, will the real value of University training be appreciated.

The whole question of Education is undergoing a change, but it must of necessity be slow. A sound education for all is undoubtedly the best investment of the State. The question is not, "Can we afford free education," but "Can we afford to do without it?"

PHYSIOGRAPHIC NOTES FROM THE UNIVERSITY OF WESTERN AUSTRALIA.

THE PHYSIOGRAPHIC ELEMENTS OF THE SWAN COASTAL PLAIN.

By W. G. Woolnough, D.Sc., F.G.S., Professor of Geology.

(*Read 13th August,* 1918.)

The city of Perth stands upon the banks of the Swan River, here a mature stream flowing across a sandy plain some twenty miles in width. This plain has been described as the Swan Coastal Plain by Jutson in his comprehensive account of the Physiography of the State.*

The author desires to point out some details in connection with the structure to which attention was not drawn by Jutson in his more general account. On the east the plain is bounded by the scarp forming the western boundary of the Darling Peneplain.†

Between the laterite-capped summit of the Darling Peneplain and the reefs of Rottnest Island, Garden Island, etc, the author believes that at least a dozen distinct physiographic elements may be recognised. (See Fig. 1.)

(*a.*) The summit level of the Darling Peneplain.

This rises to a remarkably uniform level of about 800 feet above sea level and extends almost without variation in character for at least 200 miles in a north and south direction. It is capped by laterite and is intersected by deep youthful river valleys, carved out of it since its upheaval.

(*b.*) The edge of the Darling Peneplain is formed by a sharp escarpement, the "Darling Scarp," due, proximately, to the undermining of the hard laterite capping by the forces of erosion. While, as Jutson has pointed out, this feature is a fault scarp, the present edge of the plateau is not coincident with the actual fault plane, but has retreated some distance to the east of the earth-crack as a result of erosion.

(*c.*) West of the cliff-like edge of the laterite capping is a hill slope, generally fairly steep, leading down to the edge of the plain itself. This element we may call "the Foothill Zone." On these foothills are exposed the basement rocks of the Peneplain, chiefly granites in great variety, seamed with dyke-like masses of basic and ultrabasic intrusive rocks, mostly somewhat recrystallised. From

*Jutson, J. T. : An outline of the physiographical geology (Physiography) of Western Australia. Geol. Survey of W.A., Bulletin 61, p. 44, 1914.

†Loc. cit., p. 42, 43, where references to previous literature are given.

Gosnells to Mundijong, at least, there appear at intervals exposures of slaty rocks, dipping at high angles, and apparently surrounded completely by eruptive materials.* In places, also, enormous quartz reefs, or sections of one great quartz reef, are met with (Brunswick, Gosnells, etc.).

This exposure of relatively fresh and undecomposed basement rocks bespeaks the rapid erosion which is going on throughout the foothill zone.

(*d.*) At several points along the outer part of the foothill zone there appears a laterite-covered shelf at a very strikingly uniform elevation of about 200 feet above sea level. It appears, rather obscurely, at Greenmount and Armadale, much more decidedly at Ridge Hill, the lower part of the Kalamunda Road, and Waroona. The appearance of this laterite at all points, and its relationships at Ridge Hill and Kalamunda, seem to distinguish it from the widely-distributed detrital laterite described by Simpson† as occurring at low levels. Much more research will have to be carried out before the existence of this shelf as a definite independent element can be claimed. Tentatively, however, we may suggest its existence and explain it as the remnants of a step-faulted portion of the plateau, let down by a subsidiary fault, immediately to the west of, and parallel to the main Darling Range fault.

For this somewhat hypothetical element I suggest the name "Ridge Hill Shelf."

(*e.*) We reach now the main "Darling Fault" which has been responsible for the entire structure of the region, and which separates the isostatically adjusted uplift area on the east, and subsidence area on the west. The actual fault plain is not known to the author at any point, the line of junction of the ancient crystalline rocks of the plateau and of the recent accumulations of the plain being hidden by detritus. Of the existence of such a fault, however, there can be no doubt, and of its tectonic importance there can be no question.

(*f.*) The "Piedmont Zone" follows next in order and is of the utmost economic importance. Steep-grade, rapid streams flowing down from the youthful valleys of the plateau element bear with them the well rotted detritus derived from both granites and "greenstones." On reaching the plains these streams have their velocity checked and are forced to deposit their sediment as flat alluvial fans or dry deltas. The streams are legion, and deposits of adjacent streams uniting at their lateral edges, build up an almost continuous, gently sloping zone of alluvial matter right along the base of the main hill feature. Containing as it does a modicum of potash derived from the felspars of the granites, and quite a notable amount of lime ob-

* Honman, C. S., The Extension of the Kelmscott Clay Deposit. Bull. Geol. Survey W.A., No. 48, 1912, pp. 63-65.

†Simpson, E. S.: Laterite in Western Australia. Geol. Mag. n.s. dec. v. vol. ix., p. 399-406, 1912.

tained from the greenstone, the soils of this piedmont zone are, relatively, somewhat rich in plant food. The distribution of land suitable for citrus fruits, limited on the west by a line approximating to the South-Western railway is determined by the extent of this zone.

Each alluvial fan is slightly convex in profile and its stream occupies a notch on this convex surface. This introduces a tendency to instability of location of the channel, and there are probably instances of streams having left the convex surface to flow into the intervening hollows. Mostly, however, the streams occupy notches on the fans, a feature which is evidenced by the occurrence of the viaducts along the railway line at the summits of the grades in many instances. (A very good example of this is at Keysbrook.) The outer margin of the piedmont zone is lobate, and cusps of the plain run in between the lobes. The width of the belt varies considerably with the magnitude of the constructive streams, but is probably only from half to one mile on the average.

(*g.*) The "Sandy Plain" follows the piedmont zone on the west. Into its constitution a number of sub-elements enter, whose relations vary considerably from point to point. As a whole the sandy plain is gently undulating, but quite sharp gradients are by no means infrequent. These are caused by the dominating structures of the region, namely, sand dunes of æolian origin, geologically recent, but sufficiently old to have been fixed completely and permanently by the growth of vegetation. Between these dunes there stretch low lying areas. During the extremely wet winter season the level of ground water rises to the surface in such localities, and we have swampy areas filled with coffee-coloured peaty water. These swampy areas come to contain a moderate amount of clay substance and humus so that, when drained and cultivated, they become quite valuable agricultural land, particularly for market gardens. The Chinamen's gardens in the immediate vicinity of Perth are examples.

Quite distinct from these smaller sporadic lagoons, there is a well-defined zone of large and shallow, but more or less permanent, lakes stretching along a north and south line between the hills on the east and the coastline on the west, including, amongst others, Lakes Jandakot, Bibra, Herdsman, Monger, etc. The origin of these lakes is under investigation and will form the subject of a further communication to the Society. Beyond the "Lake Zone" the sandhills of the plain continue to the west as they do to the east, but they become more pronounced and individualised, probably because more recent, in this western section.

(*h.*) Forming a continuous belt facing the coast, rising into very respectable hills (Buckland Hill 207 feet), and projecting seawards as rocky headlands honeycombed with large and small cavities, is the zone of "Coastal Limestones." Formed by æolian action on the existing coastline, and composed largely of comminuted mar-

inc calcareous organisms, these rocks have been consolidated superficially into dense travertine ("cap-stone") in many places by alternate solution and precipitation of carbonate of lime. As a result of this mode of origin concretionary structure is very wide spread. Travertine formation has been very irregular, or else solution channels have been frequent, or both factors in development have been operative. As a result extraordinary "nigger-heads" and "teeth" of limestone have been formed or left amongst the less solid sand. These are well exhibited in the railway cuttings near the Show Ground and in the river bank near the boat-sheds at Peppermint Grove.

Plant roots have formed channels for percolating water and may, perhaps, have contributed organic solvents during life or during decay, so that the segregation of calcium carbonate has been directed, in its first stages at all events, by root distribution. The structure lines so initiated have been extended and enlarged, producing the arborescent rods of limestone which form so striking a feature of the railway cuttings between Cottesloe Beach and North Fremantle.

False bedding has been extensively developed during the formation of these rocks and gives rise to very striking features in the topography produced by them (for example, near the Mount Lyell Chemical Works at Rocky Bay).

In places (*e.g.*, North Fremantle) the superficial crust of limestone is sufficiently pure to be burnt for lime, while at various places in the Metropolitan area the subjacent calcareous sandstones have supplied rather inferior building stone and road metal.

(*k.*) Next in succession we come to the actual "Shore Line" of the Indian Ocean. This is composed mostly of sandy beaches backed by actively moving sand dunes, which, in places, are encroaching very seriously upon residential and industrial areas. Extensive rocky promontories are scarcely existent, but small headlands of coastal limestone alternate with the sand beaches. A well-defined wave-cut platform of limestone is recognisable in places at a level such that it is extensively exposed at low water. The significance of this platform is being discussed in another paper by Mr. J. L. Somerville.

(*l.*) In the immediate neighbourhood of Fremantle the shallow waters of "Gage Roads" enclosed between the shore and the Rottnest Island to Rockingham Bay reefs constitutes another physiographic element of no mean importance.

(*m.*) The zone of islands and reefs extending through Carnac and Garden Island and, perhaps, Rottnest Island, forms the most westerly of the physiographic elements included within the scope of the present paper. The author has not had an opportunity of examining them personally.

It is obvious, of course, that a method of subdivision like that attempted above is to some extent a matter of convenience. The various elements shade off into one another in many instances so

that no sharp line of demarcation can be drawn. In other cases portions of the different elements overlap and become intermingled, so that, for instance, we not infrequently find the tops of sandhills cropping up through the red soils of the piedmont zone.

The deposits of the larger streams, essentially resembling those of the piedmont in composition, may extend completely across the sand plain and limestone belt to the sea, while the development of a considerable river valley introduces features which tend to mask those of the coastal plains. It is in areas between the larger streams that the consecutive elements of structure can be recognised most clearly. The best point of outlook known to the author is to be found on the crest of the hills east of Armadale. In this paper no attempt has been made to deal with the question of stream development in the area, nor to account for the well defined and extensive coastal lakes and estuaries which present so striking a feature of the topography from Bunbury to Mandurah. These have been reserved for future study and communication to the Society. No bibliography has been included and few references have been given, as Jutson (*loc. cit.*) has provided all that is necessary in this particular.

GENERALISED SECTION ACROSS THE SWAN COASTAL PLAIN.

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a. Summit level of Darling Peneplain (laterite-capped).

b. Darling scarp.

c. Foothill zone.

d. Ridge hill shelf (laterite-capped).

e. Main Darling fault.

f. Piedmont zone with relatively rich soil.

g. Sandy plain with sand hills (some of them limestone capped), lagoons, and lakes.

h. Coastal limestones.

k. Shore line.

l. Shallow roadstead.

m. Garden Island reef.

CAUSES WHICH LED TO THE COLONISATION OF WESTERN AUSTRALIA.

By J. S. Battye, B.A., LL.B., Chief Librarian, Public Library, Perth.

(*Read on 10th September, 1918, by invitation of the Council.*)

Although there is a certain amount of evidence which would lead to the belief that the existence of a continent to the south of the East Indies was vaguely known nearly four centuries ago, and there is definite evidence that Dutch voyagers touched at various points of the western coast of this great continent during the 17th century, no attempt was made to do anything in the way of establishing a settlement until the third decade of the nineteenth century, some 40 years after the erection of the penal colony at Botany Bay. That the Dutch made no attempt to exploit the resources of the new land was more than likely due to the fact that they were fully occupied in the task of securing wealth from their possessions in the East Indies, whilst the reason that no other nation had its attention directed to the possibilities for colonisation that might exist was possibly the secrecy with which the Dutch surrounded their discoveries. Some authority for this is to be found in the statement of the English Ambassador at the Hague in the time of Charles II., Sir William Temple, who gave it as his opinion that: "A southern continent has long since been found out," which he said was "as long as Java, and is marked on the maps by the name of New Holland, but to what extent the land extends either to the south, the east, or the west, we do not know." To the same authority we are indebted for the declaration that the Dutch East India Co. "have long since forbidden, and under greatest penalties, any further attempts at discovering that continent, having already more trade than they can turn to account, and fearing some more populous nation of Europe might make great establishments of trade in some of these unknown regions, which might ruin or impair what they have already in the Indies."

This statement has been vigorously denied by the Dutch, but the fact remains that of the voyages made by the Company little was known until the publication of the instructions issued by the Governor General of Batavia to Tasman on his second voyage in 1644. This curious document was found by Sir Joseph Banks in 1770 when turning over the old archives at Batavia, and was published by Sir Alexander Dalrymple in his Collections concerning Papua.

The Dutch voyages were followed from 1688 to 1818 by the English voyages of discovery and survey, notably those of Dampier,

Vancouver, Flinders and King, all of which brought back to England accumulative and definite information concerning the western coast of New Holland. Even with this information, however, in its possession, the British Government took no steps towards the foundation of a settlement on any part of this wide area. In all likelihood this was owing to the unsatisfactory reports on the new territory brought back by the navigators, who, confining themselves to the more or less uninviting coast line appear to have made little or no examination of the interior, and so to have missed the more fertile districts further inland. Another contributing cause may have been the fact that the population of the old country, depleted by the long Napoleonic wars, had not reached that congested state which made it necessary for the Government to further the establishment of new colonies as outlets for the surplus people. At the same time, private enterprise was scarcely likely to be attracted to the new country, as the only inducement in those days to leave the comforts of civilisation was the almost certain knowledge that fortunes, great in extent and rapidly gained, were to be secured by a few years exile.

All these excuses for the non-fulfilment of her destiny on the part of Great Britain appear to have, however, gone by the board when the suspicion entered into the minds of the British people that other nations, and more particularly the French, were contemplating new settlements in the South seas. It is impossible to ascertain how those suspicions arose, as an exhaustive examination of the policy of Napoleon fails to reveal any suggestion in his mind of Australian colonisation, and although during the long years of his captivity on St. Helena, Napoleon discussed very freely his projects, as well as his successes and failures, with those around him, no mention appears ever to have been made of any project of that character.

That the suspicion existed in the minds of the members of the British Goverment there is, however, ample evidence, and this suspicion had also communicated itself to the Directors of the East India Company one of whom, the Hon. C. F. Greville, wrote to Brown, the naturalist of the "Investigator," in 1802, a letter in which he said: "I hope the French ships of discovery will not station themselves on the coast of New Holland."

In his "Recollections," Lord Russell states that during his tenure of the Colonial Office, a member of the French Embassy called upon him and asked what portion of Australia was claimed by Great Britain, to which he replied, "the whole." As Lord John Russell was Secretary of State for the Colonies from 1839 to 1841, it seems strange that that question should have been asked at that late period, but possibly the scientific researches of French navigators at the beginning of the century may have been present in the Frenchman's mind.

Again, the Earl of Ripon in 1833, with regard more particularly to Western Australia, said: "The present settlement at Swan River owes its origin, you may perhaps be aware, to certain false rumours which had reached the Government of the intentions of a foreign power to establish a colony on the west coast of Australia. The design was for a time given up entirely on the ground of public economy, and would not have been resumed but for the offer of a party of gentlemen to embark in an undertaking of this nature, at their own risk, upon receiving extensive grants of land, and on a certain degree of protection and assistance for a limited period being secured to them by this Government."

[It is now generally accepted that the French expeditions of the period had one of two objects in view, either the advancement of science or the discovery of the fate of La Pérouse.]

Having thus discussed shortly the attitude of the British mind towards French activities, let me turn more particularly to the causes which led to the colonisation of Western Australia, and which are to be found in the statement noted above made by the Earl of Ripon—Firstly, the fear of French annexation; secondly, the offer to colonise on the part of a syndicate.

It is not necessary to inform you that rumours existed early in the century that Admiral Baudin contemplated a settlement at Western Port in 1802, and that Freycinet, in 1818, had made an exhaustive examination of the north-west coast. In 1825 we find that a further French expedition, consisting of the "Thétis" and "Espérance," commanded by Bougainville and Du Camper, was cruising about the southern coasts, and this seems to have made General Darling, who towards the end of that year had assumed the governorship of New South Wales, anxious that some steps should be taken to deprive France of the chance of gaining a foothold on Australasian soil. Recognising that, in case of dispute, Great Britain would have difficulty in establishing her claim to the west coast, he wrote to the Secretary of State for the Colonies regarding the matter, and said: "It will not be easy to satisfy the French, if they are desirous of establishing themselves here, that there is any objection to their doing so on the west coast, and I therefore beg to suggest that the difficulty would be removed by a commission describing the whole territory as within the Government." (The territory of New South Wales, it may be mentioned, extended westward only to the 129° of E. Longitude.) On 1st March, 1826, the Secretary of State, Lord Bathurst, addressed two despatches upon the subject to Governor Darling, and, at the same time, wrote a more or less private and confidential communication. The first of these despatches instructed the Governor to commence immediate preparations for the formation of a settlement at Western Port, using whatever means he might think best. In the second despatch Darling was instructed to endeavour to procure correct information respecting the country im-

mediately adjoining Shark Bay, ostensibly for the purpose of establishing a base to which convicts, reconvicted of lighter crimes at Botany Bay, might be sent and "that possession may be gained of a port which it may hereafter be found important to have retained." In the private communication the Secretary says, "The sailing of two French ships on a voyage of discovery have (*sic*) led to the consideration how far our distant possessions in the Australian seas may be prejudiced by any designs which the French may entertain of establishing themselves in that quarter, and more especially on that part of the coast of New South Wales which has not as yet received any colonists from this country. I allude to that line of coast which extends to the westward from the western point of Bathurst Island in 129° E. Longitude. . . . . As this tract of shore is understood to be for the most part barren and devoid of all circumstances which could invite settlement, it is probable, if the French Government should entertain any serious intention of forming an establishment on that side of the continent, any island with so advantageous a port as Western Port would not be overlooked by them . . . . . In giving those instructions you will observe that I have carefully avoided any expression which might be construed, in the event of the instructions being hereafter referred to, as an admission of there not having been a preoccupancy by us before the French may have admitted to establish themselves there, and you will regulate your language accordingly. The establishment to be formed at Shark Bay is, as you are aware, partly for a different object, but it is equally necessary that our projects in that quarter should not be anticipated."

The advice to Darling to regulate his language probably explains why there was no public proclamation of any intention on the part of the Government to establish a settlement.

On the 11th March a further despatch was sent to the Governor asking him also to have an examination made of the country around King George's Sound, as it might possibly prove a better locality than Shark Bay. In all probability these despatches were forwarded by the same ship. At any rate, they were answered by Governor Darling on the 10th October, 1826, who stated that, in his opinion, King George's Sound was unsuited even for a penal settlement, and that Shark Bay was even worse, but that he would have an examination made and added, "The French would, therefore, find it difficult to maintain themselves at either of these places."

Immediately after the receipt of the instructions, the Governor took steps to have them carried out. Three sites for occupancy were determined upon, at Raffles Bay, Western Port, and King George's Sound, and the officers in charge of the three expeditions were confidentially advised "to avoid any expression of doubt as to the whole of New Holland being within this Government, any definition of it which may be supposed to exist under the designation of New South Wales being merely ideal, and intended only with a view of distin-

guishing the more settled part of the country. Should this explanation not prove satisfactory, it will be proper in that case to refer them to this Government for any further information they may require." They were also instructed that if a landing should have been already effected by the French, "You will, notwithstanding, land the troops agreeably to your instructions, and signify that their (the French) continuance with any view to establishing themselves or colonisation, would be considered an unjustifiable intrusion on His Britannic Majesty's possessions."

These three expeditions, all of which numbered convicts amongst them, duly established themselves at the points mentioned, that at King George's Sound being founded on Christmas Day, 1826, and continued until March, 1831, when the convicts were withdrawn, and the settlement brought under the then new colony at Swan River.

Meanwhile, the arrival of the French corvette "L'Astrolabe," at Sydney, in December, 1826, after spending a month at King George's Sound, accentuated the fear of French annexation, and in Governor Darling's opinion made it still more necessary that some British settlement should be established on the west coast.

Fortunately, the opportunity of taking the initial steps towards that end was ready to hand. A settlement had been established at Melville Island on the north coast in 1824, which had, from the commencement, been a failure. In consequence, the Secretary of State instructed Governor Darling to send a war ship to the island for the purpose of removing the settlement to some more suitable site, preferably further to the east. When the despatch arrived it so happened that H.M.S. "Success," commanded by Captain Stirling, was lying in Sydney Harbour, and the Governor appears to have communicated the wish of the British Government to Captain Stirling in an unofficial way, as the first intimation we have upon the matter is in the form of two letters from Stirling to the Governor, in the first of which, dated 8th December, 1826, it was pointed out that the north-west monsoonal rains would interfere with the removal of the settlement at Melville Island until after April, while in the second dated December 14, Stirling suggested that instead of remaining in harbour until the following April, he should employ the time in making an examination of the Swan River. In the prosecution of these considerations, he says "Certain ideas have been suggested to me by professional observation, relative to the necessity of immediately seizing a possession upon the western coast of this island near Swan River." . . . He concludes his letter with this statement: "Finally, Sir, at a time when we have one French vessel of war with objects not clearly understood, and with one American vessel of war being also in this neighbourhood seeking a place for settlement, it becomes important to prevent them from occupying a position of such value, particularly as you were pleased to say that His Majesty's Government is desirous of not being anticipated in such views by any

foreign power." On the 18th December, the Governor forwarded a despatch to Lord Bathurst, stating that he had agreed to Captain Stirling's proposal "as it is of great importance that so advantageous a position should not be taken possession of by the French. . . . At the same time, if the French meditated a settlement in New Holland, Swan River, from the accounts given of it by Captain Stirling, should not be neglected."

In pursuance of these arrangements, Captain Stirling left Sydney on the 17th January, 1827, in the "Success" for the Swan River, with the ostensible purpose of making up the French survey deficiencies, and of thoroughly examining all the country within a reasonable distance of the river. He took with him Mr. Charles Fraser, who was at that time Colonial Botanist in New South Wales. The "Success" anchored off the south head of Swan River on the 6th March, 1827, and early on the morning of the 8th, Stirling proceeded to carry out the real objects of the expedition, which were "to proceed, if possible, to the source of the river, to examine the banks and the depth of water, to fix upon an eligible spot for the settlement, to ascertain the products of the country, the nature of the soil, and the practicability of forming a harbour for shipping."

For the purpose of fulfilling these instructions the ship's gig and cutter were provisioned for a fortnight and well armed, after which, under the command of Captain Stirling, they proceeded up the river. Mr. Fraser formed one of the party. No difficulties were met with until they reached the flats above Heirisson Islands (the site of the present Perth Causeway), where the water was too shallow to float the boats, which had to be unloaded and drawn across. After that the way was tolerably easy, and on the 13th they arrived at what they deemed to be the source of the river.

"At daylight on the 13th," says Captain Stirling, "we were as usual in motion, and observed little variation in the appearance of the land as we ascended, except that the hills on the banks were higher and more frequent, and the soil upon them of a coarser description. They are here composed of a red sandstone, red clay, and an ochry loam, varying between red, brown, blue, and yellow. The soil on the lowlands continued as good as ever. About an hour before starting we had the misfortune to stave the cutter on a sunken tree; lead and fearnought, however, speedily effected a cure, and we continued to pursue our course amid increasing difficulties from similar obstructions, and from the decreasing width of the stream. The hills around us were high, and we ascended them with ease, but it was in vain that we sought a view of the country; we were the more disappointed because its character was evidently changing. At length, after several halts, we reached, about 11 o'clock, a spot where the river takes an eastern direction, just above a considerable creek on the left hand. We there found insurmountable obstructions to our further progress, in fact, we have reached the termination

Far beyond this there was the bed of a torrent, but no longer a river, nor even a continuation of water except in a succession of distant parts. Here, then, on a high bank we pitched our tent. The richness of the soil, the bright foliage of the shrubs, the majesty of the surrounding trees, the abrupt and red-coloured banks of the river occasionally seen, and the view of the blue summits of the mountains from which we were not far distant, made the scenery round this spot as beautiful as anything of the kind I had ever witnessed."

During the course of the trip two gardens were planted about 15 miles up the river, and after some trouble friendly intercourse was established with the natives. The soil along the banks was examined and an abundance of fresh water found. An ascent of the hills, to which the name General Darling Range was given, was made by Mr. Fraser. The cutter then returned to the ship, leaving the gig, with Lieut. Belches in charge, to make a hurried examination of a tributary river (the Canning), to which the French had given the name of Moreau Inlet. After her return the crew of the frigate was employed surveying the islands of Rottnest, Berthollet (now Carnac), and Buache, as well as the adjacent rocks. On Buache a garden was planted (from which probably the present name, Garden Island, was derived), and some cattle and sheep left there. The "Success" sailed for Geographe Bay on March 21. Here Stirling remained until the 25th, when he set his course for King George's Sound, which was reached on April 2. He remained at the settlement, which did not come up to his expectations, until two days later, when he left for Sydney, arriving in Port Jackson on the 15th of the same month, having been absent about three months.

So far as their reports go, both Captain Stirling and Mr. Fraser seem to have been greatly impressed with the possibilities of the newly-examined country. The latter, who had certainly greater experience in judging, was, if possible, the more pronounced in his good opinion, and there is no doubt that his opinion was largely relied upon when the question of colonisation was under discussion. In concluding his report upon the natural history, soil, etc., of the Swan River district, he says: "In delivering my opinion on the whole of the lands seen on the banks of the Swan, I hesitate not in pronouncing it superior to any I have seen in New South Wales eastward of the Blue Mountains, not only in its local situation, but in many existing advantages which it holds out to settlers, viz.:—

(1.) The evident superiority of the soil.

(2.) The facility with which settlers can bring their farms into a state of culture from the open state of the country, the trees not averaging more than ten to the acre.

(3.) The great advantage of fresh water springs of the best quality, and consequent permanent humidity of the soil—two advantages not existing eastward of the Blue Mountains.

(4.) The advantage of water carriage to their own doors and the non-existence of impediments to land carriage.

These favourable reports so impressed General Darling that he forwarded, on April 21st, 1827, a despatch in which he strongly advised the Home Government to establish a settlement at Swan River as quickly as possible. In this despatch he points out: "As Captain Stirling's visit to Swan River may attract attention and the report find its way into the French papers, it appears desirable, should His Majesty's Government entertain any intention of forming a settlement at that place, that no time should be lost in taking the necessary steps."

Stirling's report and the Governor's despatch appear to have been conveyed to England by Stirling in person, and were forwarded by the Colonial Office to the Admiralty for an opinion in regard to the formation of a settlement at Swan River. The Secretary to the Admiralty, whilst admitting the physical advantages detailed by Captain Stirling and Mr. Fraser, was of opinion that the anticipations of commercial intercourse with India were fallacious, and that it was questionable whether it was advisable to form a settlement on the west while so many millions of acres of rich country remained unoccupied on the eastern side. The report concludes with this statement: "No other motive, I conceive, than the political one of preventing other nations, as the French or Americans, of possessing themselves of the south-west corner of New Holland, should induce us to anticipate them; and even in the event of its falling into the hands of the one or other of these Powers, it would be a long series of years before they could give our other colonies much annoyance."

After consideration of the various reports and opinions dealing with the question, the Secretary of State for the Colonies wrote to Governor Darling on the 28th January, 1828, reviewing the adverse report from the Admiralty, and concluding: "Under these circumstances, I am of opinion that it would be inexpedient, on the score of expense, to occupy this part of the coast, and that it is unnecessary, with a view to any urgent interest to attempt any new settlement at present in that quarter. . . . . I shall not fail, however, to apprise the East India Co. of the circumstances attending the discovery of Swan River in case they should consider it advisable to make any settlements there, but I am not aware of any sufficient motive to induce them to embark in an undertaking of this nature."

Two days later another despatch was forwarded in which it was hinted that the same causes would probably induce the Government to withdraw the settlement which had been formed at King George's Sound, but that if it were finally decided to maintain that settlement, then, in all probability, the decision not to found a colony at Swan River would be reviewed. This decision was conveyed by the Colonial Office to Capt. Stirling, but it does not appear to

have dissuaded him from continuing his solicitations for the establishment of the new colony.

In May and June, 1828, the Earl of Dudley, Lord Palmerston, and Messrs. Grant and Huskisson retired from the British Cabinet and a reconstruction of Government followed, under which Sir George Murray replaced Mr. Huskisson as Secretary of State for War and the Colonies, and Messrs. R. W. Hay and Horace Twiss became Under Secretaries. This last appears to have been to some extent a personal friend of Captain Stirling, and it was probably through him that Stirling was induced once more to approach the Government with the idea of forming a colony. On the 30th July, 1828, he addressed a long letter to the Colonial Office in which he said, *inter alia*, "The French, under the command of Monsieur Baudin, at the beginning of this century visited that shore (that is, Western Australia) and rendered an account of it more circumstantial, but equally unfavourable, as that of the Dutch. The report which I had the honour to make last year to His Majesty's Government differs so widely from that of the preceding Dutch and French navigators, that it will scarcely be believed that we undertake to describe the same country. For while they report the country as sterile, forbidding, and inhospitable, I represent it as the land out of all that I have seen in various quarters of the world that possesses the greatest natural attractions." He then went on to describe the character of the country, and concluded: "The above-mentioned recommendations point it out as a spot so eligible for settlement that it cannot long remain unoccupied. . . . as, by its position, it commands facilities for carrying on trade with India and the Malay Archipelago as well as with China, and as it is, moreover, favourably circumstanced for the equipment of cruisers for the annoyance of trade in those seas, some foreign power may see the advantage of taking possession should His Majesty's Government leave it unappropriated."

On the receipt of this letter, Stirling's original report was apparently looked up, and the whole question re-submitted to the Admiralty. The Secretary to the Admiralty, after a conversation with Captain Stirling, more particularly concerning the merits of Swan River as compared with King George's Sound, exhibited a complete reversal of the previous Admiralty opinion, and in reply to the Colonial Office (under date 2nd August) said: "I think there requires no hesitation in transferring the establishment at the former (King George's Sound) to the latter place (Swan River), and perhaps the sooner the better, as the publication of the chart containing so fine an anchorage, entirely overlooked by the French navigators, may induce that nation, or the Americans, who are prowling about for some detached settlement, to assume possession of the only spot on the western coast of New Holland that is at all inviting for such purpose, to which we could have no right to offer any resistance."

On the 21st August, Stirling forwarded another communication to the Colonial Office, in which he gives the first hint of the possibility of the formation of an association for the purposes of colonisation, and asks whether, under such circumstances, the association could secure a proprietary charter upon the principles similar to those adopted in Pennsylvania and Georgia. The Colonial Office and the Admiralty combined suggested that he should make further inquiries with regard to the question of an association, and that he did so is evident from a letter dated 22nd October, part of which reads: "But, notwithstanding this favourable inclination, objections are made against the enterprise at present, upon the following points. In the first place there is no information extant, under authority, either to the precise intentions of the Government, or of the nature of that territory, nor do any preparations exist there for the reception of settlers. In the second place, His Majesty's right to that country has never been declared, and as it is reported that the French Government contemplates the formation of a settlement in New Holland, the apprehension is entertained that an expedition proceeding there might find, on its arrival, the best positions occupied, and its aim defeated to the total ruin of the property engaged in it. . . . I take the liberty of suggesting that (the difficulties) may be obviated by despatching at once a ship of war to that quarter. Possession might thus be taken of the country, surveys commenced, and arrangements made for the reception of settlers." The latter suggestion bore immediate fruit, as on the 5th November, the Admiralty was instructed by the Secretary of State for the Colonies, to order the officer commanding the naval forces at the Cape, to despatch one of the ships of war under his command, without loss of time, to the coast of New Holland, with directions to take formal possession in His Majesty's name, and with the further direction that the spot should be at, or near, the Swan River, and that uninterrupted possession be maintained until the arrival of further advices.

These instructions were immediately put in hand, and Admiral Schomberg, the Commander-in-Chief at the Cape, was instructed to detail H.M.S. "Tweed" for the purpose of carrying them out. A couple of days later it was found inadvisable to adopt that course, and the orders were revoked. At the same time, H.M.S. "Challenger," under Captain Fremantle, was despatched from London, and arrived at Cockburn Sound on the 2nd May, 1829. Formal possession was immediately taken by hoisting the British flag on Arthur's Head. Although this action set at rest the question of actual possession, there does not appear to have been, at that time, a definite decision to establish a colony forthwith. Such step was, however, decided upon within the following month, and was accelerated by the fact that Captain Stirling's suggestion to form a syndicate had taken definite shape in the meantime.

On the 4th November, 1828, a syndicate composed of Mr. Thomas Peel, Sir Francis Vincent, Mr. Edward Schenley, and Col-

onel T. Potter Macqueen, forwarded a memorial to the Secretary of State, offering to provide shipping for the purpose of taking out ten thousand persons within a period of four years, and to find these persons in provisions and necessaries allowed to immigrants. Further they would take to the settlement a thousand head of live stock, and have three small vessels running between Sydney and the settlement as occasion required. They estimated that the cost involved would be £30 per head, £300,000 in all, and in return, asked for land at the rate of one acre for every 1s. 6d. of that amount, or four million acres in all.

Acting upon what they considered to be a personal assurance of the Secretary of State that their proposal would be accepted, they proceeded to incur expense to the extent of £20,000 in purchasing a vessel and supplies. Then some inkling was received, apparently personally, as there is no correspondence upon the matter, that all was not well with their proposal, and, on the 2nd December, they wrote again to the Colonial Office asking for a written acceptance. Four days later they received a reply to the effect that their proposals would be accepted except as to the extent of land they would receive, the Government being prepared to allow only one million acres. Evidently this decision was not satisfactory to the members of the syndicate, who, one by one, withdrew from it, leaving Mr. Thomas Peel to carry the whole burden. He then decided to accept the Government's offer himself and made an attempt to carry it out. With the results of that attempt we are not concerned here, but it may be mentioned that the scheme was a complete failure from every point of view.

We are, however, concerned with the original syndicate's offer to this extent, that it seems to have been the one additional factor necessary in order to enable the Government to make up its mind, for we find that on the 12th November the Secretary of State for the Colonies addressed a letter to the Admiralty asking that a ship be provided for the purpose of conveying a detachment of troops and other persons to the western coast of New Holland "where it is intended to form a British settlement," and, on the 29th November, the Commander-in-Chief of the Army, Lord Hill, was asked to provide a detachment "to be held in readiness for embarkation for the western coast of New Holland, where His Majesty's Government judge it advisable to establish a British settlement." Judging from a letter, dated December 28th, Captain Stirling was personally informed that he was to be appointed to the command of the new settlement, but the formal appointment was not made until the 30th. On the following day the administrative establishment was appointed.

Although, as I have said, the proposal of the syndicate seems to have given just that additional weight necessary to tip the scale in favour of colonisation, the principal reason, according to the documentary evidence, was a recrudescence of the fear of French annexa-

tion, because we find that when the decision had been arrived at, and the arrangements completed, the Commissioners of the Treasury were asked to provide the necessary financial assistance on that ground alone. In a despatch from the Colonial Office to the Treasury, dated 31st December, 1828, we find the statement that: "Intimation having been received that the French Government are prepared to colonise some part of the west coast of New Holland, and especially that portion adjoining to the river lately explored by Captain Stirling, the Secretary of State has thought it expedient to send out that officer to form a small settlement in that quarter to which such persons may advantageously resort as may be desirous of establishing themselves in a climate as favourable as New South Wales, and a soil as promising, without the disadvantages which attach to a penal colony." Additional evidence of the fact may also be found in the despatch forwarded to Governor Darling of New South Wales on the 12th January, 1829. After drawing the Governor's attention to a previous despatch of January, 1828, in which he was informed of the grounds which induced the Government at that time to relinquish all idea of colonising the west coast of New Holland, the Secretary of State goes on to say, "Circumstances have since occurred to render the occupation of that position desirable."

This completes, so far as I am aware, the documentary evidence concerning the reasons which induced the British Government to establish a colony in Western Australia. From that evidence it seems to me to be abundantly clear that practically the only reason was the fear of French annexation, though it is doubtful whether that fear would have been sufficiently strong to cause the Government to come to a decision had there not been the offer of the syndicate. This proved that there were, in England, men of financial stability who were confident that a new colony on the west coast could be made successful. We may perhaps add to these reasons a further motive which seems to underlie all the correspondence, namely, the knowledge that existed in the minds of the members of the Government that one or two small settlements on the eastern side of this great island could not, according to the canons of international law, be deemed to be sufficient to enable Great Britain to successfully maintain a claim to the whole of the continent.

ACCLIMATISATION.

By Hon. Walter Kingsmill, B.A., President of the Legislative Council

(*Read 8th October,* 1918.)

For the purposes of definition, acclimatisation may be divided into two heads—domestication and naturalisation. In the few remarks I have to make, my principal references will be to the latter division. Combining the two, it is sufficient to say that in the history of mankind there has been no more potent factor towards civilisation and progress than the inherent tendency in man to surround himself, wherever he may go, with the plants or animals to which he has been accustomed in his country of origin. It is, therefore, naturally to be expected that England—the wanderer, the Ulysses amongst nations—has played a most important part in spreading throughout the world the various products of the vegetable and animal kingdoms which her sons have used in their homeland. Always there is an effort made to create in the many countries beyond the seas to which their roaming tendencies have brought them—another England.

This tendency, above referred to, whilst it has given to many countries of the world practically all that makes life worth living, does not always make for good, and through this strange development of home-sickness we have to-day in Australia rabbits, foxes, sparrows, starlings, thistles, and many more examples of this proclivity to consider a new home undesirable without the surroundings of the old.

But, on the other hand, it may be said that in the Greater Britain beyond the seas, Englishmen have brought with them to the land of their adoption nearly everything that has made that land a fitting home for them. Perhaps the most wonderful instance of the value and success of acclimatisation may be found in New Zealand. From the evidence at our disposal, it appears probable that some 600 years ago these lovely islands were without human inhabitants. Of mammals there are none; of reptiles very few. The fish in the rivers were confined to the members of a few insignificant and useless species. Birds, indeed, in plenty. Man first made his appearance from some of the South Sea Islands, bringing with him the dog and the rat. Then came Cook, the circumnavigator, and released pigs, which there found their island home so much to their liking that they flourished exceedingly.

With colonisation there were introduced deer, trout, and salmon, and to-day we see a land which, in comparatively recent historical time, was practically devoid of life, looked upon now as a sports-

man's paradise, and visited yearly by many thousands of people to enjoy the resources which have been created by acclimatisation.

That this subject has more than a sentimental significance may be gathered from the fact that some of our great industries are built upon its products.

Take, for instance, the rubber industry in the East Indies, where all the trees cultivated are the progeny of a few Para rubber trees (*Hevea Braziliensis*) introduced to Singapore less than 50 years ago. The same is the case in connection with the quinine industry in Java, whence a very large proportion of the world's supply of this indispensable drug is obtained but, perhaps, speaking as I am to an Australian audience, I might well depend upon the example of an acclimatised animal which has done more to add to the wealth of Australia than any other—I refer to the merino sheep.

One advantage of acclimatisation is that it is not one-sided. As well as receiving benefits, most countries give them in return, and instances of this are not lacking in the case of Australia. We have sent our eucalypts practically all over the world—in North America, South America, Southern Europe, South Africa, Asia, the Tasmanian blue gum has become a familiar tree, while South Africa to-day is sending us, to tan our leather, wattle bark taken from trees the progeny of those introduced into that country from Australia.

Before the war, annually, large numbers of our kangaroos were sent to Germany for release in public and private parks, and the German people much appreciated, as a food, the flesh of this much under-rated animal.

Coming now to what has been done in Australia, we find that in Tasmania, the Island State, the first instances of useful acclimatisation have taken place. How the enthusiasts of the Sixties and Seventies managed with the slow transport facilities of the day to bring from the Homeland the ova of trout and salmon is hard to understand. However, this feat was accomplished, and in their new home these fish did well and in a few years provided the stock for the New Zealand rivers. Red deer, too, sent from Tasmania, were the progenitors of those which now range the hills of Maoriland.

The other Australian States followed this lead either by the expenditure of Government funds or by the liberality of public-spirited individuals, until we see to-day that nearly all the streams reaching the ocean on the eastern and south-eastern coasts provide excellent trout-fishing, and some of these fish are found in the tributaries of the Murray and Darling River system. Deer, too, have been introduced in many places and have done well. English pheasants and partridges would, perhaps, have stood a better chance of success had it not been for the fact that in an excess of zeal some enthusiastic devotees of the chase found it necessary for their peace of mind to hunt the fox in the land of their adoption, and this ani-

mal, finding his new surroundings to his liking, has increased to such an extent as to become one of the most serious pests that Australia has yet seen and, in conjunction with the domestic cat returned to a state of savagery, has rendered the successful rearing of ground game almost an impossibility as well as destroying in very large numbers our rare and beautiful smaller fauna. To come to our own State, acclimatisation work may be looked upon as a plant of quite recent growth, and while at first the soil in which it grew was enriched by the attentions of those in power in granting moderately generous amounts to this most national and useful of objects, at the present day, when, to continue the analogy, our plant has blossomed and begun to bear fruit, its sustenance is curtailed to such an extent as to threaten its very life. Surely an instance, even if a small one, of faulty husbandry.

In Western Australia the principal efforts of those controlling the work have been directed towards the acclimatisation of freshwater fish in our rivers, lakes and other available waters, and in this, with the experience gained through initial mistakes, a fair amount of success has been attained. To-day, in nearly every river and stream in our Southern districts, English perch may be found, and in some places the fishing will compare very favourably both for quantity and quality with any part of Australia. This fish seems admirably adapted for life in our waters, accommodating itself, apparently, without difficulty to the many changes and chances of temperatures and salinities met with in different localities. Perch have been taken up to seven lbs. in weight, and in the waters which have been stocked for the longer periods fish of four pounds and over are not infrequent. With the increase in size, an improvement in edible qualities is associated: an occurrence which is somewhat unusual. On the whole, the English perch has been found to be easily the most suitable and adaptable fish for our freshwater areas.

During last year 1,000 fish, in 100 different consignments, were sent to parts of the State as far apart as Sandstone in the North, to Manjimup in the South. These fish are delivered free of all charge at the nearest railway station or siding to the home of any settler who is willing to take charge of them, release them in the waters in which they are to live, and return the cans in which they have made their journey to the station for carriage to the depôt at Chidlow's Well. The distribution of fish alone necessitates, in addition to the provision of the fish which are caught, caged (to ensure their better travelling) placed in the cans and taken to the station at Chidlow's Well, a large amount of inspectorial and clerical work, the former to ascertain whether the waters for which fish are required are suitable as regards size, depth, temperature, salinity, food supply, etc., and the latter in answering letters of application making arrangements for inspections, giving notification to consignees of the despatch of fish and other numerous directions. All this in-

spectorial and clerical work is carried out by honorary effort, and even then, when it is considered that the grant for all branches of acclimatisation work (and fish form only one of the branches), amounts to only £75 annually, it must be admitted that the State receives excellent value for its money, and further that an undertaking such as this which has already given to hundreds of settlers the opportunity of obtaining from the streams or lakes near which they live, or even in many cases from the dams which they themselves have sunk, an abundant and every-ready addition to dietary scale which, in many instances, is unhealthy because of its monotony, is surely worthy of a more generous recognition and a larger measure of monetary support than is now being accorded to it.

To return from this financial digression, it may be noted that in the case of trout our experiments have not been so satisfactory as with perch. In former years, when funds were available, experience was lacking; and to-day, when by the experience we have gained we know where these fish would flourish, we cannot, apparently, obtain the necessary money to carry out this work, which is slightly more expensive than the cultivation of perch.

Many years ago Murray cod, obtained from South Australia, were placed in Grassmere Lake, near Albany, but it was only when some twenty years after the cutting of a drain lowered the level of the lake that, by the stranding of many large fish, it was found that they had done well. Specimens of over 60lbs. in weight were found and opportunity is now to be sought to place yearlings of this fine food fish—the largest of the perch family—in such waters as by their comparative isolation will not render the voracity of this species a menace to existing fish life.

Early attempts were made to introduce tench and carp. In the case of the first-mentioned the attempts were happily unsuccessful. As regards carp, however, these fish obtained more or less of a footing, but they are not any longer being distributed.

Looking to the future of fish culture, it must be admitted that there is still much to be done. In addition to extending the scope of our present work by introducing trout to the suitable streams which, by examination, have been proved to exist, it is eminently desirable that an effort should be made to bring to our shores some of the food fish of other lands, and the shad, one of the finest and best of the herring family, is at once suggested. The numerous inlets and river mouths on our coast would provide ideal breeding and feeding grounds for this fish, and that it will repay expenditure in acclimatising it is evidenced by the fact that many years ago consignments of these fish and of striped bass, another fish suitable for us, were sent right across America from East to West, released on the Californian coast, and now form a large proportion of the fish supply of Western America, and play an important commercial part in the lives of many people.

But then it is well to remember that in America they pay some attention to matters of this kind.

In relation to the introduction of birds suitable for sporting and food purposes, it has always been necessary to exercise the greatest care in the selection of species which, while fulfilling the above qualifications, would not prove destructive.

Pheasants and partridges have been tried, but so far without much success, as they fall easy victims to the ravages of cats, etc.

With guinea fowl, however, the case is different, and it is now found that along our coastal districts following roughly the belt of tuart timber which exists for some two hundred miles or so within a few miles of the sea, these birds are doing very well and increasing to such an extent that it is permissible to hope that in a few more years, with the additional stock which is always being turned out, and the natural increase, good sport and a valuable food supply will be available.

In districts further inland, for reasons at present not apparent, they do not succeed so well.

Black African spur-wing geese are also being distributed, but it is, as yet, too early to pronounce a verdict on them. Should, however, the experiment prove successful, this bird, which in South Africa is much thought of, should prove a valuable addition to our resources.

The same remarks apply to the Canadian wild geese, recognised as one of the finest game-birds of the world, of which specimens have been sent to one or more districts, the numbers being necessarily limited by paucity of funds.

The mallard, or English wild duck, in the Zoological Gardens, and in some of our city parks, rear each year large clutches which fly away into the country, but this species is not by any means an improvement on our own native black duck.

Doves of two species are being continually despatched to applicants in various country districts and do well, especially where pine trees exist for them to nest in. Along the Darling Range and between the same and the ocean for many miles the laugh of the kookaburra is becoming a familiar sound, and applications are coming to hand for more supplies, showing in what high estimation this typically Australian bird is held.

In this short record of what has been done with the scanty means at our command, the efforts which have been made, in some cases successfully, to acclimatise mammals, must not be lost sight of.

The Scottish red deer, the noblest of its tribe, has formed the subject of experiment in three localities in the neighbourhood of Albany, close to Cape Leeuwin, and in the unoccupied tract of practically useless land between Pinjarra and Rockingham.

In the two first-named districts, from causes hard, if not impossible to ascertain, no success has followed, but in the case of

the last-named experiment the results have been excellent. From deer released some twelve years ago there has been established a herd numbering probably over 150 head of remarkably fine specimens which run in this sandy, scrubby stretch of country, and seem to flourish therein quite as well as in their native land.

Indian black-back, a handsome and harmless antelope, has been tried with success on our Murchison country, and a small but steadily increasing herd of these animals is frequently seen in the vicinity of Wiluna. There is such a large extent of our inland dry country suitable for these antelopes that it seems a pity that the necessary funds to place more of them in our back blocks cannot be found.

The Indian hog-deer, too, would do very well in the swampy country of our South-West, but, again, lack of money stands in our way.

It is impossible in a short paper to do more than to merely touch upon the salient features of what has been accomplished in the face of great difficulties in our State, but those who are interested in the subject may perhaps be allowed to hope that in the future those controlling the affairs of Government may be induced to view with a more kindly eye than has hitherto been the case, efforts to carry out this work which, it must be admitted, has an important bearing on the comfort of the everyday life of those dwellers in our agricultural and pastoral lands whose welfare should be important to us all.

SOME ASPECTS OF TOWN PLANNING.

By W. A. Saw, Vice-President of the Town Planning Association of Western Australia.

(*Read 19th November*, 1918.)

A publication of the Homestead Commission, Massachusetts, United States, America, states that Town Planning means:—

"Conservation of human energy and preservation of life, particularly child life; *not* merely superficial beautification.

Economy, necessity, scientific reality; *not* extravagance, dreams, fads.

Conformity to a definite plan of an orderly development into which improvement will fit as it is needed; *not* immediate execution of the whole plan.

Saving in cost of public improvements by business methods for city business; *not* the surrender of the city to artists with vague schemes for city adornment.

Correlation of the city's activities; *not* wholesale alterations at great expense with no assured financial returns.

Encouragement of commerce and facilitation of business; *not* the interruption of business and commerce.

Preservation of historic buildings with their traditions; *not* the destruction of the old landmarks and city individuality

The rule of common foresight and prudence; *not* the rule of chance with ruinous expense and debt.

Happiness, convenience, and health to all citizens; *not* merely expensive boulevards and parks available only to the rich."

Who can say of the vast army of the unemployed how large a portion of the industrially inefficient are so because of lowered physical vitality caused by disadvantageous living conditions? To what extent is the forbidding atmosphere of so many homes an element in the problem of inebriety? Of the burdens which the State is called upon to bear in the support of almhouses for the dependent, hospitals for the sick, asylums for the insane, prisons and reformatories for the criminal, what portion can fairly be attributed to early adverse environment?

What other Countries are doing.

In 1874 Sweden passed an Act in which it was made compulsory that "For every town there shall be prepared a plan for its general arrangements and of the building within it, including the streets, the

markets, and other public places. It shall be adopted by the Town Council, and finally submitted to the King for his approval or rejection.

In Italy it is compulsory that every town of 10,000 inhabitants *must* have its town-planning scheme.

In England, France, Italy, United States, Sweden, Canada, Nova Scotia, and Germany, town-planning has been in force for years. Even during the war England has spent many millions and has other large schemes in hand. In London the architects, engineers, surveyors, and city officials are working on a comprehensive plan covering housing and traffic routes over an area of 2,000 square miles round London. In France, the Senate have passed a law which provides that every city, town, or village in France, regardless of whether it is in the destroyed area or not, will be forced to lay its future developments according to modern city planning principles.

Belgium has appointed a board of town-planners to deal with the existing, as well as the ruined, towns.

Australia must awake and keep up to the other nations of the world in the march of progress. We cannot afford to lag behind them.

It must not be forgotten also that, *now the war is over,* some 30,000 soldiers, strong, able-bodied, virile, vigorous men, the best of our race, will return to Western Australia, and while we hope that many will take up rural occupations, yet it is almost certain that the majority of them will settle in towns and suburbs. This means more rapid development than heretofore. Are we therefore to let the present happy-go-lucky style of expansion go on, and add to our present difficulties? Let us be wise and plan in advance of settlement.

City Beautiful.

This is a term we are constantly hearing, mostly in terms of levity, or sarcasm, but it is possible that those who use the term do not know what it means, and have a very poor conception of what town-planners are aiming at.

We are not theorists and idealists. Town planning involves essentially practical considerations. Its bearing on public health should be sufficient to ensure for it the attention it deserves in a country which recognises the value both of population and the efficiency of the individual units.

We see in Australia, this "glorious land of open spaces," our large cities congested with physically crushed and mentally warped men and women.

We note the squalid environment, breeding crime and disease. We watch death stalking through the slums, and marking down the defenceless child, passing it out without even a fighting chance. In this "land of magnificent distances" Sydney has an infant death

rate of 11.7 per cent. We in Australia are so crushing our houses together that the death rate of our children is greater than that of London, where 9 per cent. go out in their first year. Yet with proper city planning as at Port Sunlight, England, the death rate can be lowered to 3 per cent. Some years ago this State had the highest infant death rate, under one year, in the Commonwealth, at one time over 14 per cent., but during 1916, 1917, and 1918 it is probably the lowest in the Commonwealth, being slightly over 6 per cent. of the births, or 60.5 per 1,000 births. Under 5 years the deaths averaged 23½ per cent. of the whole deaths. The total death rate is 9.3 per 1,000 of the population.

We must do better than we have done in conserving our baby life by taking greater care of the mothers of the nation. We can augment our man power best by improving the workmen's homes, by beautifying them individually, and in the mass, by preserving the sanctity of the home and keeping the flag "one family, one house" flying by abolishing overcrowding; by getting the factories and the workers out into the environs of the city by rapid communication services to zones where land is cheaper, where air is pure, and where the children, in their garden villages, will grow up taller, stronger, deeper in the chest, freer from physical defects, happier, more likely to be stalwart effectives in the wealth-creating forces of the State, and less likely to be a burden on the community. We wish to look ahead, and plan for the future as well as the present, to save piling up an unnecessary burden on the next generation, which, in many cases, we can now prevent without cost to ourselves.

We wish to seize the opportunity when it presents itself, as our means allow, and at the lowest possible cost, to rectify some of the many mistakes made in the past, which, if not dealt with, will become more accentuated as time goes on. Unimproved land costs less to purchase than improved land.

London Conference.

Now, in 1910 a Town Planning Conference was held in London, and there were present 368 delegates from 214 Corporations, Councils, and Societies from all parts of the world.

The Right Hon. John Burns, M.P., was the President and welcomed the delegates on behalf of the Prime Minister and His Majesty's Government. Mr. Burns was the author of the English Housing and Town Planning Act which was passed by Parliament in the year 1909. I quote a few extracts from his address to the delegates:—

"Environment has a wonderful effect on character. It is not an accident that the beautiful manor house, the restful vicarage, the stately homes of England, and the beautiful public schools and colleges have turned out the Ruskins, the Kingsleys, the Morrises, the Nelsons, the Newtons and the Darwins.

Cities are not only emporiums for goods, centres of commerce and trade. They are something more than a mere cash nexus: they are places where utility, comfort, and beauty can be and ought to be combined, so that the passer by can, from what he sees, feel something to which his sense of beauty and of domestic comfort can respond all the better for having lived in and seen beautiful buildings every day of his life; places which by their beauty, their amenity, their grace, and, above all, their greenery, create a joy in life which we Britons sometimes lack, and give a spacious leisure in idle moments, when study wants a respite, and honest labour requires a pleasant rest.

The people of our poorer towns suffer not only from lack of means, they suffer from poverty of spirit. Their dismal temper is often caused by their squalid environment. Every day we see children's characters spoiled, their natures stunted by the depressing circumstances in which they live.

Spoiled lives in the soiled homes, in the slatternly streets, are often causes of dirt, drink, degradation, loafing, and dependence in many of our big cities. When a slum vanishes, a brewery falls and public houses disappear. The mean street produces the mean men, the lean and tired woman, and the unclean children.

So long as casual labour broods in squalid lairs, in sunless streets, and ugly dwellings are its only habitation, we shall continue to turn out nervous mannikins instead of enduring men.

Motherhood, childhood, youth, society, and the race demand the demolition of the soul-destroying slum. They ask for the pleasant town, the comfortable yet dignified city.

The artisan is now securing houses at rents and of a character and beauty that were not within the reach of the average artisan 25 years ago. But, we have to think of those lower than the artisan; we have to think of the great mass of mankind, the hewers of wood and the drawers of water, the skilled, the unskilled, and, above all, the casual labourer; and the responsibility rests upon us in house and town planning to see that the labourer is provided with infinitely better housing and street accommodation than he now secures.

The expanding village wants town planning as much as does the large city; the growing town clamours for town planning; but, most of all, the straggling suburb round the ever-changing city gives a stimulus whose call we ought to have answered years ago. For all these reasons—industrial, social, commercial, and imperial—town planning must go hand in hand with better housing, higher wages, and increasing sobriety."

United States and Canada.

Now, many people in Western Australia consider that town planning is a fad, not worth wasting time over, but the people of the United States and Canada are recognised even by our critics as

being smart, cute, and up-to-date. They know and have proved that it is a money-saving proposition. Listen to what Mr. Daniel H. Burnham, Chairman of the Committee of Fine Arts, U.S.A., and the creator of the Chicago Exposition, said at the London Conference in 1910:—

"The inception of great planning of public buildings and grounds in the United States was in the World's Fair in Chicago, 1890. The beauty of its arrangement and of its buildings made a profund impression, not merely upon the highly educated part of the community, but still more perhaps upon the masses, and this impression has been a lasting one. As a first result of the object-lesson, the Government took up the torch and proceeded to make a comprehensive plan for the future development of the Capitol, Washington. This action was less than ten years ago, up to which time there never had been a Plan Commission in the United States, but since then every considerable town in that country has gone into this study, and there are many hundreds of Plan Commissions at work at the present time throughout the land. Is this a fad, an attractive occupation of the moment, an interest which will dissipate and pass away? Is it a mere plaything, or does it mirror urgent needs, never before felt, but now becoming essential to humanity? A review of some of the organisations may help to determine the reality of purpose with which men have now gone into this work. The Washington Designing Board was appointed by the Government, the last President of the United States, and, still more, the present one are at the back of it, and the Congress has passed an Act establishing a National Fine Arts Commission as an outcome of their efforts.

Then came the plan of Manila, capital of the Philippines, made under Mr. Taft, who was then Secretary for War, the initiative having come from him personally.

Then came Cleveland, Ohio, which State passed a special law in order to allow large towns to employ expert commissioners, who are to design the public thoroughfares and parks, and who are to act as censors in all public art matters.

Then came San Francisco, where an association of private men undertook to back the work. And then came Chicago, where the work was undertaken by the Commercial Club, which appointed a committee of 15 of its members to conduct the enterprise.

Other places have done the same earnest work, and have shown the same liberal spirit as those mentioned above. But the most significant aspect of this new phase of life in the United States lies in the kind of men who are actively engaged. They are the best and the strongest men of affairs we have. In Chicago, in three years, there were 200 meetings of the General Committee, at which hundreds of public men—engineers, architects, sanitary, railroad, city transportation, and other experts—were present. There is not one

man of the 15 committee men who is not at the head of some great business, and who is not loaded with the heaviest kind of responsibilities of his own, and yet they all make it a point of honour to be in their seats when the chairman calls to order, and not for a week or two, or a month or two, but most faithfully through years, and it is everywhere the same.

The town planning men in every city are the ablest in the community, and each one feels that he has no duty more serious or more important; and it may be of interest to Englishmen to know that, just as I was leaving Home a month ago (this was in 1910), Sir William Horn, Chairman of the Board of the Canadian Pacific Railroad, wrote to me from Montreal to say that he had taken the chairmanship of a Plan Commission and desired to consult me about an organisation for the development of that city. There you have one of the three or four first men in Canada, deliberately arranging to give his heart and hand to the kind of work we are talking about.

There are many more instances, well worth mention, all going to show that town planning is not in the hands of people who have time to waste, but you do not need any more proof. You know well that the deep interest taken in the subject throughout the world marks, not a passing fancy, but a definite step in the development of man.

Australia.

And now what is Australia doing? Neither in peace or war do we lag behind others, but rather do we strive to be in the lead.

In 1917 a Town Planning Conference was held in Adelaide at which there were 291 delegates from all parts of the Commonwealth except W.A. (Owing to the great strike and lack of transport we were unable to send delegates.) In 1918 another conference was held in Brisbane at which there were 542 delegates, but only four were from this State. There were present Cabinet Ministers, Members of Parliament, Heads of Government Departments of all the States except Western Australia, Lord Mayors, Mayors and Aldermen, Representatives of Statutory Bodies, such as Harbour Trusts, Universities, Metropolitan Board of Water Supply and Sewerage, Town Planning Associations, numerous Local Government Bodies, such as Cities, Towns and Shires Councils. Other bodies such as Institutions of Civil Engineers, Surveyors, Architects, Board of Control of the Soldiers' Garden Village, New South Wales, Master Builders, Health Society, Women's Horticultural and Home Industries Society, National Council of Women, Municipal Engineers, Chambers of Commerce and Manufactures, Editors of Daily Papers, Automobile Club, Labour Council, Women's Club, Federal Institute of Accountants, Historical Society, Horticultural Society, Pharma-

ceutical Society, Employers' Federation, Returned Sailors and Soldiers' Imperial League of Australia, Royal Geographical Society of Queensland, School for Mothers, Botanic Gardens Board, Wattle Day League, the Society of Architects, London, and the following Associations:—British Medical, Art Gallery, Journalists, Australian Natives, Trained Nurses, Traders, Timber Merchants, Children's Playground, Master Carriers, National Agricultural and Industrial, Law, Nurserymen's and Workers' Educational.

This list gives us some idea of the way in which Town Planning is engaging the attention of the public in the other States of Australia.

There are now two Town Planning Ministers, one in New South Wales, Hon. J. D. Fitzgerald; and the other in South Australia, Hon. H. W. Barwell. They each intend to place before Parliament a Town Planning Bill, and it will be interesting to see which State will have the honour of passing the first Town Planning Act in Australia.

Let me tell you of some of the things that have been done in Western Australia which could not have happened had there been a Town Planning Act in force, administered by experts:—

Slums.—We have slums in Perth and Fremantle. In East Perth there are 11 houses on one allotment of half an acre, some fronting a narrow lane only 20 feet in width.

In West Perth land is subdivided and built upon with an area of 10 perches. This equals 16 houses to the acre.

In Leederville there are lots with about 16 to 20 feet frontage and small depth. They are built upon, one room in width and no land at the side.

North of Victoria Park Station there are lots so small that 20 are required to make one acre.

In the whole of the Metropolitan Area from Midland Junction to Fremantle, it was a common thing for the owner of land to have it subdivided as he pleased, without supervision and without reference to what the next owner had done or intended to do; the consequence is that many roads end in a *cul-de-sac*, and do not connect with one another. These mistakes can never be wholly rectified, and will cost a very large sum of money to undo some of the mischief. We have wedge-shaped corners of streets, making them unsightly and dangerous to traffic. In districts subdivided by private owners sufficient open spaces have not been reserved for parks, recreation grounds and children's playgrounds. Claremont has only 1.3 per cent., Perth Road Board, including Mt. Lawley, less than 1 per cent., Bayswater a trifle over 1 per cent., Belmont Park Road Board ⅓ of 1 per cent. Town Planners advocate about 10 per cent. To give an idea as to what it has cost Perth up to the present, although it

is well provided with parks and open spaces—but they were unevenly distributed—the following is the expenditure:—

	£	s.	d.
Purchasing land for Parks and Gardens	37,000	0	0
Opening out Blind Streets—Extension and Widening	38,563	0	0
Rounding off Street Corners	1,192	0	0
	£76,775	0	0
Costs the Ratepayers at 5 per cent. each day of the year	10	10	0
Per year	3,837	15	0

This is only the beginning. We and our children will have to pay in Perth alone many tens of thousands of pounds in trying to undo the errors of the past. Then what will it cost the other towns and suburbs in this large State of Western Australia? Hundreds of thousands, possibly millions.

To prove this let us take Sydney's and Melbourne's experience—

Rounding off Street Corners.

A few years ago the Sydney Council bought 5½ square yards of a corner at the intersection of George and King Streets for which they paid £1,500. The whole block of land was purchased in 1823 for £63.

Through the action of the Town Planning Association of Western Australia, the local authorities are making it compulsory in new subdivisions to round off the corners of new streets and the Surveyor General has agreed to adopt the same procedure in new towns and suburbs. This alone will save the next generation many thousands of pounds, and at no cost to ourselves.

Sydney and Melbourne—Slums and Housing.

The Sydney Council have during the past 12 years made 83 resumptions to get rid of slums and to widen streets. Up to 1917 the total sum paid was £2,304,047, and other resumptions have since been made and there will be many more. This is not all loss; it may be recovered at the end of 50 years when building leases fall in and through the resale of some of the land. Slum houses were being knocked down when I was in Sydney last August, but what has been done in only the beginning.

Melbourne spent £100,000 to resume undesirable areas, but that sum only purchased two overcrowded block of land, and the authorities are undecided as to what to do further owing to the prohibitive cost.

The subject of Housing is a serious problem in Sydney and Melbourne and disgraceful conditions exist there. Both cities are overcrowded. The recent report of the Housing Commission which has been collecting evidence in Melbourne is a very disturbing document. It says: "In Fitzroy, a husband, his wife and three children were found living in one room. In South Melbourne, in a house of three rooms, three families were huddled. Two families, totalling eight persons, were discovered in a three-roomed house in Port Melbourne. In St. Kilda, a fashionable suburb, a bedroom 10ft. x 10ft., and with damp walls, accommodated a man, his wife, and four children."

In Sydney, Mr. A. B. Piddington (Chairman of the Interstate Commission), who is inquiring into house rents, said: "I visited without previous announcement a number of houses in the eastern suburbs of the city in order to see for myself the nature of the dwellings which a large number of people occupy. The rooms in many of the houses were small and low, and the floors rat-eaten. The back yards at almost all of the houses, on an average, would not be more than about 10ft. x 10ft. Speaking generally, I formed the conclusion that a great many of the dwellings in that portion of the city are just about on the same level as the slum dwellings which I was shown in South London."

The Prince of Wales paid a visit recently to Southwark in order to investigate the housing conditions of the poor. The Mayor asked the Prince what he thought of them. "It is damnable," he said.

The same thing will happen here if we do not take steps to prevent it. The Workers' Homes Board have done good work with the funds that were available, and the proposed housing of soldiers will assist. This latter scheme is most liberal. Up to £700 will be advanced to each approved applicant and the interest will be only 5 per cent. Thirty-seven years will be allowed for repayments when a stone house is erected, and a shorter time if of less enduring material, viz., 20 years for a wooden house.

Children's Playgrounds.

It is gratifying to know that some ladies are interesting themselves in the Children's Playground at Lake Street in Perth. The Town Planning Association has appointed some of its members to advise as to the lay-out. Children's playgrounds are of recent origin, but many cities are providing them. The idea is that no house should be more than half-a-mile from the playground. There is a Children's Playground Association of Queensland, and Miss Bedford, the Hon. Secretary, stated that: "In the Brisbane City Area there are approximately 9,000 children between the ages of three and 16 totally unprovided for as regards play centres, and, in the Metropolitan Area, taking a 10-mile radius, there are as many as 48,849 equally unfortunate, with the exception of one district."

Last year I was present at the opening of a Children's Playground at Ithaca, a suburb of Brisbane. The Ithaca Council allocated £120 for the equipment of the playground, and everything has been provided to make for the happiness of the children. At the higher end of the ground there are two buildings, one a crèche and the other a kindergarten school. They are in charge of two nurses. At the lower end there is an open air municipal bath. The playground is divided into different sections for boys, girls and infants, and is well equipped with swings, ladders, climbing poles, roundabouts, slides, wading pool, and other appliances.

One of the nurses said she had appointed 22 boys as policemen to look after the grounds and to protect the apparatus supplied for the games.

At Port Pirie, South Australia, on August 17th, 1918, a playground with its buildings, shelters, appliances, carriage drives, footpaths, plantations and playing areas was erected and completed in one day. Over 2,000 employees of the Broken Hill Associated Smelters gave their services free to do the work.

The company provided the means, and the Corporation the site. What a lot of good work can be done by co-operation and unity of purpose!

The Town Planners of this State are encouraged by the work of others in all parts of the civilised world. We have pressed steadily on during the past three years, turning neither to the right nor to the left, ever onward, determined to reach the goal we have in view, viz., the passing of a Town Planning Act.

We are endeavouring to enlist the sympathy and assistance of the Government, Members of Parliament, Local Authorities, Societies, Institutions, Associations, Leagues, Trades Hall, business men and the general public, so that they all may be interested in Town Planning and thus benefit themselves and those who come after them.

Let each one endeavour to do his or her part as the opportunity occurs, for if we do not leave a better heritage to our children than that which we received from those who have "gone before," we shall have neglected our duty and betrayed our trust.

Fig. 1.

A factory between the Swan River and the King's Park, Perth. Out of keeping with its surroundings, and causing a dangerous bottle-neck on the main road. Factories should only be allowed in selected areas.

Fig. 2.

Vista pleasing to the eye. Situated at the eastern end of Murray Street, Perth.

Fig. 3.

Vista in William Street, Perth. Tower erected by Railway Department, with side of tank used for an advertisement of whisky.

Fig. 4.

Slums in Perth.

Fig. 5.
Slums in Sydney. Fifty houses to the acre.

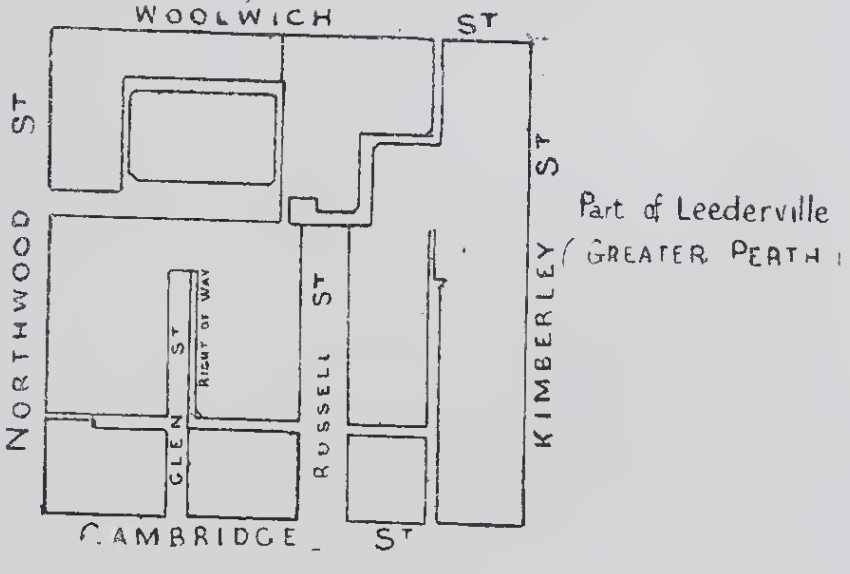


Fig. 6.
Streets in Leederville, Perth, set out without supervision. (What will it cost to rectify this error?)

Fig. 7.

South Perth. Subdivision of two estates. Note the position of the streets, many have blind ends.

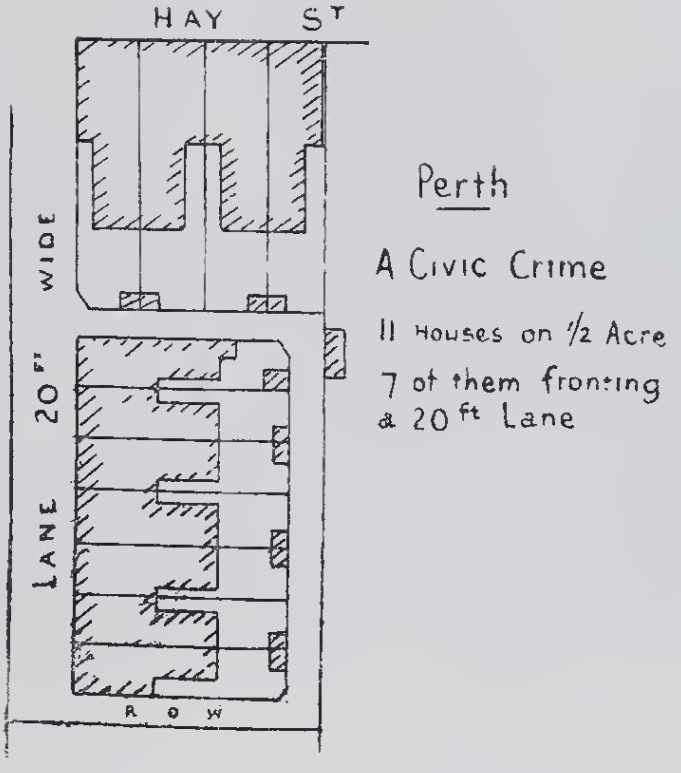

HAY ST
LANE 20 FT WIDE
R O W
Perth
A Civic Crime
11 Houses on ½ Acre
7 of them fronting
a 20 ft Lane

Fig. 8.

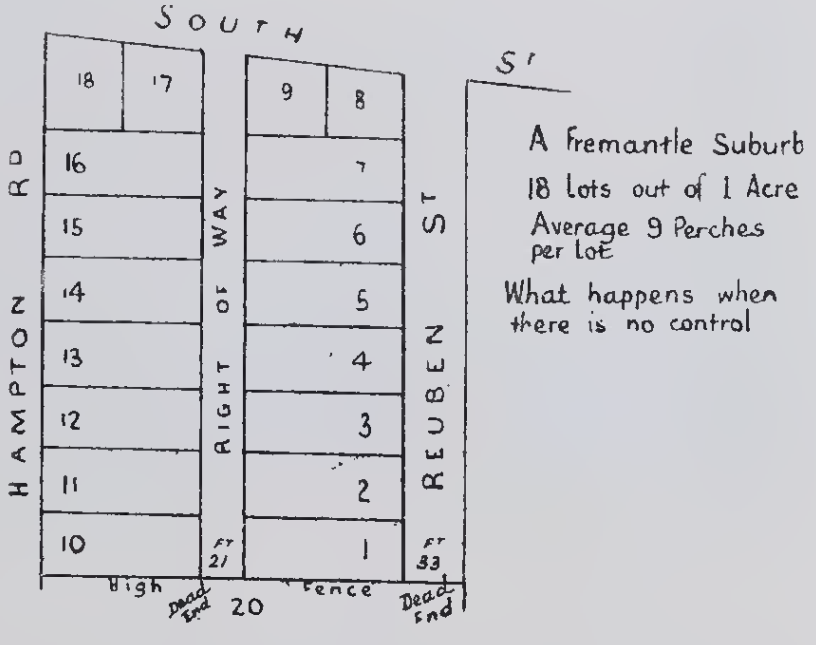

SOUTH
HAMPTON RD
RIGHT OF WAY
REUBEN ST
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
FT 21
FT 33
High
Dead End
20
Fence
Dead End
A Fremantle Suburb
18 Lots out of 1 Acre
Average 9 Perches per lot
What happens when there is no control

Fig. 9.

Fig. 10.

Wasting time and money at a level crossing in East Perth. This obstruction to traffic has existed for 28 years.

Fig. 11.

Perth Railway Station and approach. Insufficient space for future needs. The Railway Station is the entrance gate to the city, and the volume of traffic demands a broad open space leading to which wide radial thoroughfares should converge.

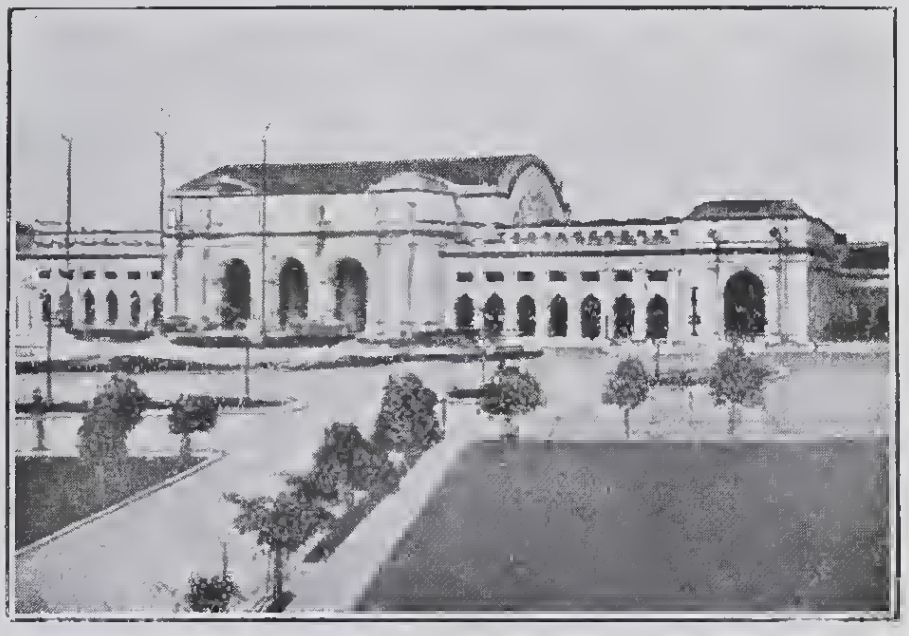


Fig. 12.

Union Railway Station—Washington, U.S.A.
(Note the area reserved for future requirements.)

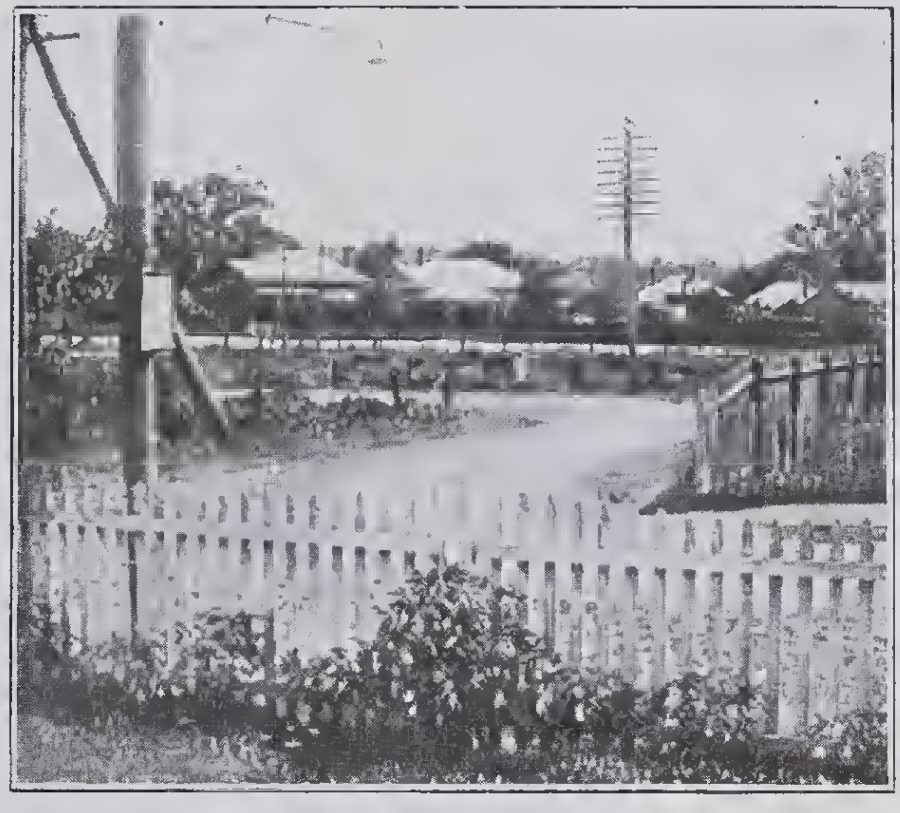


Fig. 13.

Two very dangerous corners at Claremont, W.A. (This will have to be rectified some day at the public expense.)

Fig. 14.

A 66 feet wide residential street in the metropolitan area. Expensive to maintain, ugly and dusty, and unnecessarily wide for the limited traffic.

Fig. 15.

A 20 feet residential street in a Garden City in England. The houses are set back on a building line. This is a better road than that showing in the preceding figure, costs less to construct and to maintain, and could be widened if necessity arose without compensation being paid to the landowners.

Fig. 16.

Aldwych, London. Shows rounded corners, which facilitate movement of traffic and have a fine effect.

Fig. 17.

Ord Street, Perth, showing the mutilation of trees due to poles and wires being erected in the wrong position.

Fig. 18.

Percentage of park area to city area. The districts showing the smallest are those which have been subdivided by private owners.

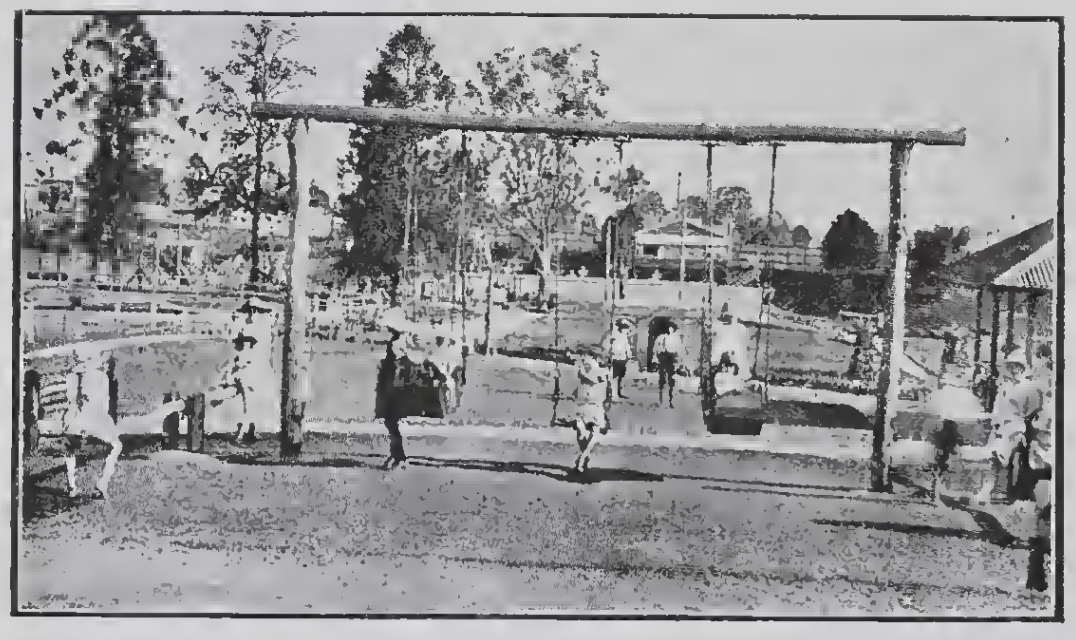


Fig. 19.

A children's playground, Ithaca, Brisbane. Many cities are now providing such playgrounds. Their promoters urge that no home should be more than half a mile from a playground.

Fig. 20.

Western Australian Worker's Home (leasehold). Three rooms and kitchen. Cost £410. Rent 12s. 6d. a week. 246 such houses have been built.

Fig. 21.

Western Australian Worker's Home (freehold). Cost and repayments not available. There are about 1,100 freehold estates on which houses have been erected. The Board has advanced over £500,000 for building houses. (The freehold system has proved more popular than the leasehold.)

Fig. 22.

North Terrace, Adelaide. Showing the treatment of a street too wide for present traffic. Note the Park Ring in the distance. The land cost under £3,000, and is said to be now worth several million pounds.

Fig. 23.

Trafalgar Square, London. Showing some of the streets radiating from this fine open space.

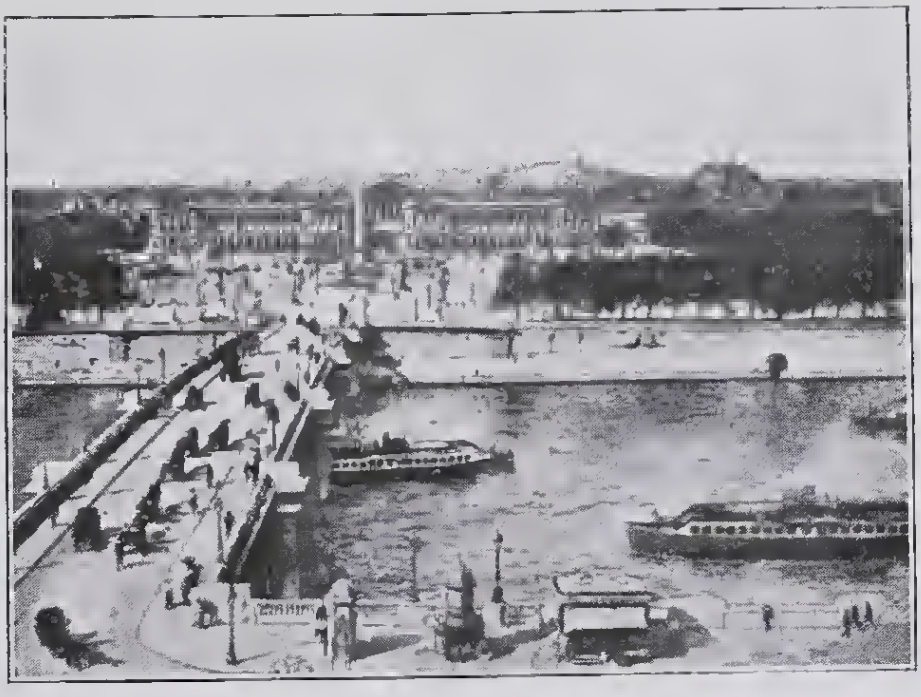


Fig. 24.

Place de la Concorde, Paris. The finest open place in any European city. (Foreign armies have encamped on this place on three occasions. The Germans were there in 1870, and intended to be there again in 1914.)

(Note.—Only a few of the pictures shown by Mr. Saw are here reproduced.)

HOUSES IN WESTERN AUSTRALIA.

By A. R. L. Wright, Licentiate R.I.B.A., President of W.A. Institute of Architects.

(*Read 11th March*, 1919.)

The subject of this paper is of a different character from those subjects usually discussed in lectures of this Society. It is, however, a very important one, as the health of the community is so largely dependent upon satisfactory housing conditions. Moreover, since we all live in houses, it is a subject of general interest: the layman as well as the architect can discover inconveniences or other faults of the house he occupies, or he has ideas of what a house should be to suit his particular views.

Speaking generally, houses must be well situated, pleasant to look upon, healthy to live in, and carefully studied in their arrangements, whilst at the same time being economically and substantially built. To secure these virtues great skill and mature knowledge are essential in the designer, probably in a greater degree than is required for a more complex and expensive building. This fact is not generally known, and all kinds of people take it upon themselves to build houses without the most elementary training for the work, whilst any architect of experience has heard enough opinions from so-called practical people to make an expert of him. It is a popular idea amongst ladies who are interested in houses that an architect either never heard of such a thing as a cupboard, or, from natural infirmity common to his class, has not sufficient skill to design one. It is difficult to remove that impression and from the houses one sees in this country I think the opinion is quite justifiable, and that is one of the reasons for the reading of this paper.

A house may be a mansion, a villa, or a cottage, but whatever it is, it should be of a design adapted to the local climate and circumstances, and of materials readily obtainable in the neighbourhood.

On this vast continent, extending through many latitudes, with varied climates, soil, and local building materials, we require many different types of dwellings. A house for Perth is not suitable for Carnarvon, nor is a country house at Kojonup right for Kimberley. The requirements are entirely different both for climate and material.

In Spain and Italy the houses differ materially from those in England in style and arrangement, and they are not interchangeable. Yet in Australia one builds houses in semi-tropical parts almost fit for an English town. As far as circumstances go, the canvas shanty

of the goldfields and the woodcutter's slab hut have more of fitness for the locality and circumstances than many of our ordinary houses.

Our usual type of dwelling is derived from England, whereas our climate and ways of living call for an Italian house, with its piazza, plain elevation, and heavily projecting eaves. We have copied our verandahs and balconies from Holland and Germany, but the inside of the house is certainly English. There has been little attempt at designing a really Australian house. One might at first glance say that the ordinary Queensland wooden houses are colonial, but they are not, their only idiosyncracy being the height they are built off the ground. This serves no good purpose, and only reminds one of the ancient Swiss lake-dwellings.

Now, many of us are trying to copy some Californian type of house, but transplanting it from a block of an acre or two to one of 40 feet or less frontage only converts it into a curtailed mongrel. More especially, when the roof is covered with that material so much prized by Australians, viz., corrugated galvanised iron of Gospel Oak, Anchor, or Orb brand. It is hateful to look at, but fortunately it is no longer cheap. As an alternative, we sometimes use tiles, but that is because they come from France. If they had originally been made in Australia they would never have come into use, for the Australian is a free lover and prefers every country's products to his own; even including soldiers' wives. For this reason, there is still only ¾ of a man to the square mile over the whole area of Australia. A country that is endowed by nature with very possible material for building, fitting and furnishing a house still rakes the furthest ends of the earth for them; as a nation I suppose we beat every other in our imports of those articles. My aim is to bring about the building *of a house of Australian type with Australian materials, for Australians to live in.*

How bountifully we are supplied with forests of building timbers of every kind, hard and soft, and of the most beautiful in the world for furniture and cabinet work. Can we find anything handsomer than the Queensland cedar or our jarrah for red timbers, Tasmanian blackwood, teak, or Queensland bean tree for brown, and all the varieties of light-coloured timbers for lining walls or ceilings, and for furniture? Eight hundred catalogued varieties in Queensland alone! And yet we import "British oak" from Austria and Japan, fir from the Baltic, and oregon from America. Some makers are actually selling furniture made of Australian timbers under the name of English oak, as they know it will sell more readily than under the proper Australian name. Why did we leave off using locally-made pantiles and our fine old sheaoak shingles and take to galvanised iron, thereby encouraging people in the dirty habit of drinking roof water mixed with the blow-off from filthy streets? If a material or an article cannot be found or manufactured in one State, it is possible to get it from another, without leaving this Con-

tinent at all. Let us be imbued with a national feeling and promote the use of our own products.

When one has the selection of one's home, one should first consider the locality, then the street, and then the block, and it is fairly certain that one will considerably modify his requirements before a decision is arrived at. Means of access, distance, surroundings, and healthiness have all to be taken into accoount. But once having settled all these points, the actual home enclosure is one's own particular business, and if one is not competent to deal with that himself, the obvious method is to consult an expert adviser, or to employ him altogether. But whoever the adviser may be, let it be certain he is not what is known as "a practical man." He is as ignorant as a Bolshevik, and as brainless as a kewpie. He is not practical, but a vain fool, and taking his advice generally entails wasted expense and dissatisfaction.

I am confining my future remarks chiefly to the metropolitan area, as the subject is too vast to travel over the State.

The foolish stereotyped method of subdividing land without respect to local features or contours, and blocks in the one locality being all of the same size, makes the choice of a building site very troublesome. Until town planning has been in vogue for many years one will have to submit to the evils resulting from this method, and suffer the harassing restrictions of antiquated municipal by-laws. These are benefits of civilisation which we shall probably confer on the inhabitants of our about-to-be-acquired German colonies who are at present living the healty life that all uncivilised aborigines enjoy.

A chain frontage is, I think, the least one can put up with. The usual 40 or 50 feet block is really too narrow for an ordinary house for a family of, say, six persons in comfortable circumstances. One's neighbours are too near, and there is not sufficient room to properly adapt the house to the proper aspect for the various compartments. The result is that one sees so many houses which are, so to speak, "too big for their boots." This is notably the case in the most sought-for localities. Houses for artisans have in this respect, a distinct advantage over others, and many of them are well and pleasantly located. But the professional man or the business man, who likes two or three sitting rooms, has a trouble in settling a house of his requirements on a block of such restricted frontage. This brings about the congested appearance that some streets present, and it produces monotony in that there is not sufficient space around the house for shrubberies, etc., which so largely conduce to the health and charm of a dwelling. The setting of a house is as important as the architectural features, which should be as few as possible, and altogether it should display dignified simplicity. One or two extremely plain looking houses about Perth strike me as particularly charming on account of the free-and-easy, not stiff, arrangement or want of arrangement of trees, shrubs, and walks.

The ever-recurring couch-grass lawns, and the neatly trimmed hedges which are gradually attaining to the height of a lamp post, pall on the passer-by, and they also display a lack of thought or interest in not devising something more varied. It is pleasanter to look at a garden where one can throw down a match, or where children can play, without causing disfigurement. The drawing-room carpet out of doors is neither comfortable nor homely. Houses not being asylums or gaols, there is no necessity for enclosing them with high hedges which hold the dust off the road and check the breeze, unless to hide the bed neatly arranged alongside the front door outside the drawing room window—an arrangement entailed by bad planning.

People might remember that there are other hedge shrubs besides macrocarpia, pittosporum, plumbago, and box. The macrocarpia or pittosporum hedges and the green patch in front of the house have been done to death in Perth, and a change is required. In many cases the absence of a hedge or fence would be a distinct improvement.

Turning our thoughts to the style of house most suitable for a suburb, we find the cottage type prevails, and rightly so, as it is simple and economical, and it can be made as pleasing as desired. Now that the garden city idea has begun to be applied to the development of suburban estates, there will be less crowding, larger gardens, more open spaces, and houses grouped with regard to architectural effect. Aspect and vista, and greater freedom of design, can then be considered. "Houses are built to live in, and not to look on," said Francis Bacon, but fortunately this aphorism was not accepted in his day, nor should it be in ours. Too often the exterior of the house seems to be designed to suit the street or road, with a pretentious front, defaced by superfluous and meritricious ornamentation whilst the sides are plain and rough, and the back mean and squalid. A house should suggest refinement, repose, and individuality, and present an honest face to every quarter. What is more vulgar than a house with the brick front painted with hideous so-called tuckpointing, and the adjacent sides of plain bad brickwork, or a boarded wall imitating stone blocks? In Adelaide I saw a house with stamped zinc imitation stone weather-boards in front and corrugated iron on the side walls! There is more sham and shoddy work about many of the modern houses than in those of years ago. The old red brick pensioner's houses present an air of honest respectability entirely lacking in hundreds of more recent erections. "Design with beauty, build in truth" is the motto of the London Architectural Association. Let us avoid shams both in construction and in materials.

The controlling factor in the design of any building is the plan. If we have higher ideals of home life, and correspondingly higher and more complex requirements in planning, these must have the most important effect on the exterior—on the style of the design.

Ruskin said something to the effect that a building in which the roof is not a prominent feature cannot be considered of good design, but he was not thinking of a galvanised iron or asbestos roof. And it is, of course, well known that in arranging the plan of a house, one always bears the roofing in mind.

In studying the planning of houses in Western Australia, it appears to be almost a rule to bring the best rooms to the front of the house, irrespective of aspect and convenience. The narrow width of frontage may, in many cases, account for this, but often it could by more consideration be avoided. Little regard is paid to the privacy of the bedrooms, and the sitting room and kitchen, where, in many cases, the lady of the house has to spend the greater portion of the time, often look out on the side fence. In many cases the sun never shines into these apartments. There shoud be no gloomy rooms, and the door of the best bedroom should not be opposite the front door.

Very great attention to the kitchen will have to be paid in future, as the lack of domestic assistance will be greater than ever. Consequently, it must be conveniently situated, of fair dimensions, well ventilated and lighted, with a cheerful lookout, and provided with every contrivance to save labour, and to render the duties performed therein as palatable as is possible. I might almost say that it should have more consideration than any other apartment. The stove should be placed so that the draught does not blow out the ashes, and with the arch high enough to allow one to look into the pots without striking one's head, and if possible it should have a light at the back of the fireplace. The sink should preferably be movable and away from the walls, not enclosed underneath, the pipe for the tap being extended and the drainpipe detachable to discharge into a fixed outlet in the floor. The walls should have a hard-faced dado all round of tiles or cement, whilst the upper portion should be oil painted, or washable distemper. No moulding or architraves, skirting, or doors should be allowed as these are dust traps, and all angles of walls should be rounded at intersections and at floor and ceiling. The cupboards for crockery should have glazed sliding doors, and the pots should be placed on proper shelves, or hung on proper bracketing, and not have to be deposited on the floor. If the sink or table have to touch the wall, the dado should be high enough to keep splashes off the main portion of wall. If there is no ice-chest, there should be a cool safe set against a louvred opening in an outer wall.

The laundry should be adjacent to the kitchen, and a decent apartment, not a rough shed. The copper-boiler and tubs should have lids, and there should be an ironing-table and hinged skirt board to fold up against the wall. The walls should be at least of neat brickwork whitewashed, or jarrah boarding, the ceiling of painted jarrah boards, with a ventilator, and the floor of polished

cement concrete, vintoid, or red earthenware squares. There should, if possible, be a broom-cupboard, or otherwise suitable pegs.

The other rooms would be designed to suit the individual tastes of the owner, and it is not possible to deal with them *in extenso* in this paper. I think, however, that economy of labour, and simplicity of design should govern the general rooms. For small rooms it is not necessary to have them as lofty as the larger ones; 10 feet, or even nine feet, would often be sufficient height. The position of doors and windows and fireplaces should be carefully studied with an eye to the emplacing of furniture. Windows should extend as far down to floor and up to the ceiling as possible. The air above window openings is more or less stagnant. The style of window should be varied to suit the rooms. A simpler treatment of woodwork should be adopted; the prevalent moulded architraves, skirtings, and cornices could more fitly be plain to avoid harbouring dust and to look less vulgar than many I have seen. The centre-flower in the ceiling, and the coved cornice, might well be dispensed with. The modern way of treating the ceiling and deep frieze in continuation to the picture rail is a good and pleasing practice. The treatment of the walls can be simple or more elaborate, all according to taste and fitness.

In a wooden house, the walls and ceilings, instead of being plastered, might be of Australian timber boarding, divided into panels by plain strips if funds will permit. Where plastered or boarded the ceiling might also display the ceiling joists with good effect.

The trade size of doors is of unpleasant proportions, the metre unit gives a better appearance. The four panels have also had a long run; let us have something fresh. On the continent of Europe doors very often have curved heads and look well. Folding or sliding doors are often more convenient than doors in one leaf for large rooms. Bedroom doors should have opening fanlights.

The fixed lavatory with water laid on is, to my mind, a good innovation for bedrooms, as the principal washing is done in the bath-room. With a neat tiled back it could be made a pleasing feature in a room, and save labour.

In houses with a drainage system there should be a slop sink in proper closet.

The dining room should have near communication with the kitchen. One should not have to pass the front door nor walk a 30ft. passage to bring in meals.

Although many people have another opinion, I hold that a visitor should be able to go into the dining or drawing rooms without passing a bedroom door, and I know no good reason for placing the principal bedroom in the front of the house, unless it is for the owner to be handy to attack an intruding burglar, who, by the way, seldom enters by the front door.

There should be ample cupboards for linen, stores, clothes, boxes, etc., conveniently disposed about the house. There is a sad lack of these necessities in most houses.

The bathroom is, I am pleased to say, an object of great interest to most Australians, and where means allow, it is everything that it should be. The modern custom of putting it *in* the house, instead of on the back verandah, or under the house among the piles, as they often do in Queensland, is where it should be. It might be still better placed amongst the bedrooms, and not between the drawing and dining rooms as in many cases I know. In passing plumber's shops, I note that plain galvanised iron baths are still sold. They should be prohibited, as also the sinks of the same material. If one cannot afford the expense of the enamel steel bath, the locally made cement ones are a good substitute. The washtroughs of this material are fortunately gradually coming into use, and are within the means of all householders. The English pattern of common stoneware sink is a very suitable article and is made here, but, on account of some regulation I understand the imported steel one must be used. As I have before stated, it should be possible to use local manufacture for everything about a house: the demand will create the supply. We should copy the Americans in thinking that what our own country produces is best for us.

Before leaving this part of the subject, I wish to call attention to the usual position of the E.C., mostly obtrusive and unsightly, inconvenient in sickness, and probably very often the cause of colds. If there is a sewerage system, there is no good reason against having it inside the house. If otherwise, it should be nearer the dwelling and camouflaged by attachment to a woodshed or washhouse. As at present, it is a vulgar abomination. The inside treatment is also bad and rough. Hard, smooth-plastered ceiling and walls, or wood lining, and a good close floor, either of cement or wood, are requisite. The seat should invariably be of polished jarrah; in England they always use polished mahogany. The existing by-laws should be altered to suit these requirements.

Regarding the materials for constructing the house, the primary factor is cost. One should, if possible, employ materials obtainable in the locality; stone or brick, if available, otherwise wood, asbestos, slate, or a mixture of all. The now popular red brick and cement rough-cast for walls, and red tiles for the roof, are not easily improved upon. The qualities to be avoided, both in bricks and tiles, are those which many people seem to value most highly—brightness, uniformity of tint, and smoothness of surface, thereby producing a stiff doll's-house appearance. One should use those with accidental variation of tint, which aids artistic effect, and tones down to a pleasant mellow harmony. Very often a more rugged and massive style of walling might be erected; the pretty, smooth kind prevails too much. Good bricks and tiles are now made locally, or elsewhere

in Australia, and even though the first cost of the latter is relatively high, they permanently add to the duration, comfort, and appearance of a building. The makers will, however, have to produce a lighter plain ridging to replace the existing clumsy and heavy one. Cheap plain flat red tiles in varied shades should also be manufactured for use on roofs and as alternative covering for walls. Slates and iron are both stiff in appearance, and the latter allows the heat to pass through.

The verandah is a very important part of a house, for besides protecting it from the sun's rays, it serves the purpose of a sitting place, and, now-a-days, it is in general use for sleeping out. It is therefore, worthy of being treated as an integral portion of the building, and instead of the general paltry construction with much unnecessary woodwork and mean turned posts, it would be more dignified with stout columns or masonry piers, heavy beams and a good roof. The floor should preferably be of concrete or tiles—red earthenware squares being very suitable. In the country, a verandah around the house seems to be appropriate, but in town or the suburbs it is sufficient to have one in a suitable position, not necessarily near the entrance, of spacious dimensions, for sitting about, and another for sleeping out near the bedrooms. This latter might be louvred or enclosed with fly-proof gauze, or it might have windows and louvres. At any rate, the air should be always in motion through the verandah, and the beds should not be exposed to public view, as they generally are. Wall beds might be used where space is limited.

The oscillating portal wall-bed is a very convenient method of disposing of the beds out of sight in the daytime, but of course this adds considerably to the initial cost of a house—about £40 per bed.

Sleeping-out, with thick blinds hung on to the verandah, is hardly more healthy than sleeping indoors.

It is strange that although most houses have the roof pitched fairly high, no use is made of the space between that and the ceiling. It is a great waste of space. Without going to much expense in the way of a staircase, a plain flight of stairs could be constructed and a large portion of the roof space enclosed as attics. These could be used as servants' bedrooms and box rooms, or provide a good playroom for children. Of course, the size of the attic would not conform to the size of the rooms below and it would be unnecessary to carry up the lower walls. Single boarded partitions only would be required in the attic, and asbestos or plaster boards would form the ceilings and keep out the heat. Dormer windows properly placed would give plenty of ventilation, and, if properly constructed, there is no reason to fear that attics would be too hot.

Respecting wooden houses, the municipal authorities wrongly restrict their erection to certain areas in the suburban townships, thereby greatly damaging our timber industry, and entailing unnecessary additional expenditure for brick or stone. In many cases

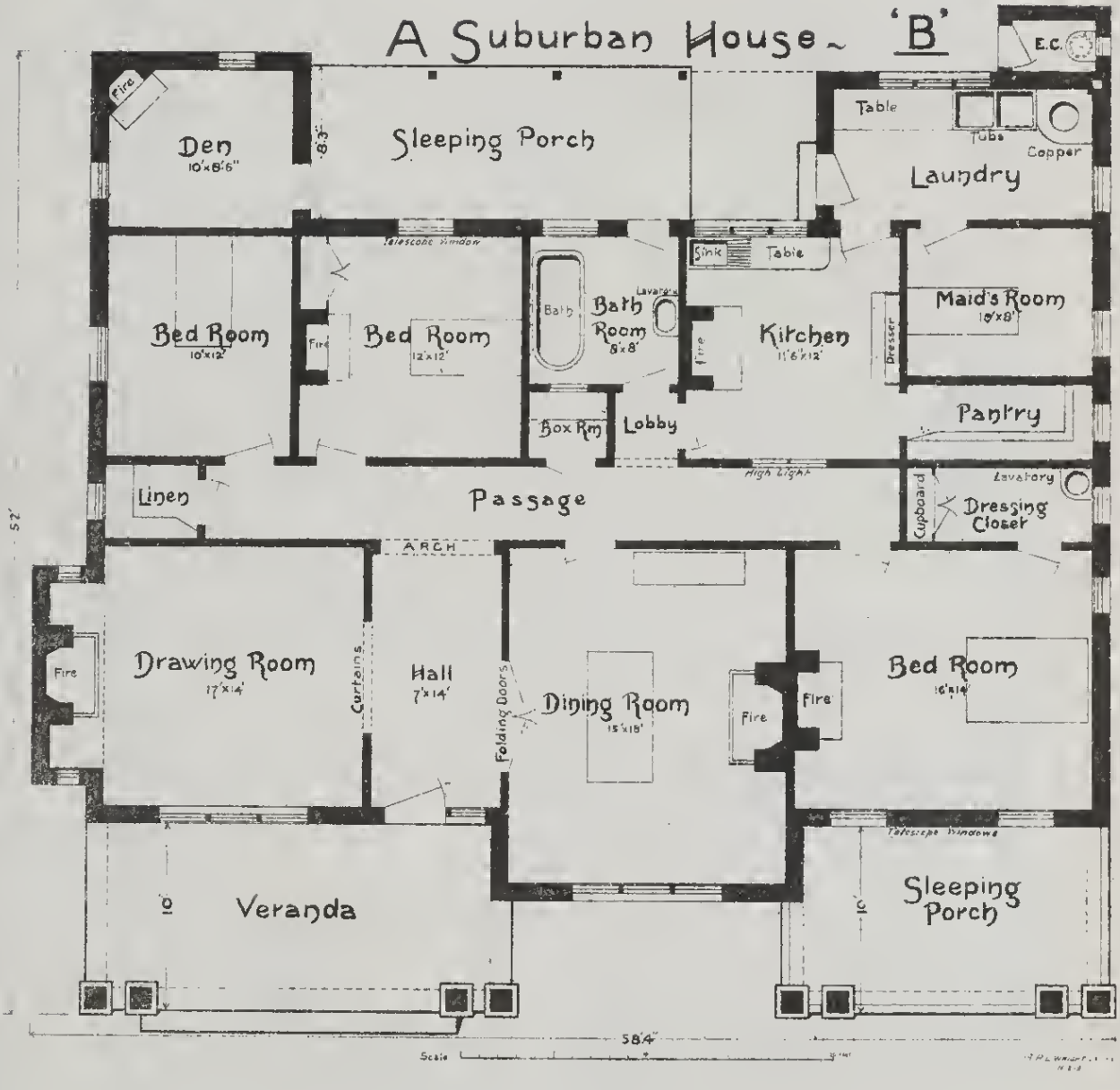
this leads to people refraining from building. There is a foolish prejudice against wooden houses, whereas you all have seen in magazines, cinemas, etc., what delightful timber buildings are erected in America. I do not refer to Queensland as, although the houses there are principally wood, they are generally of such mean type that one would not be induced to employ that material after seeing them. A house with stone or brick base and walls partly of weatherboards and shingles of tiles, pleasingly intermixed, can be made to satisfy the taste of most people. It can be rendered absolutely water-tight and to last a century. Such a house with proper insulation in walls is cool in summer and warm in winter.

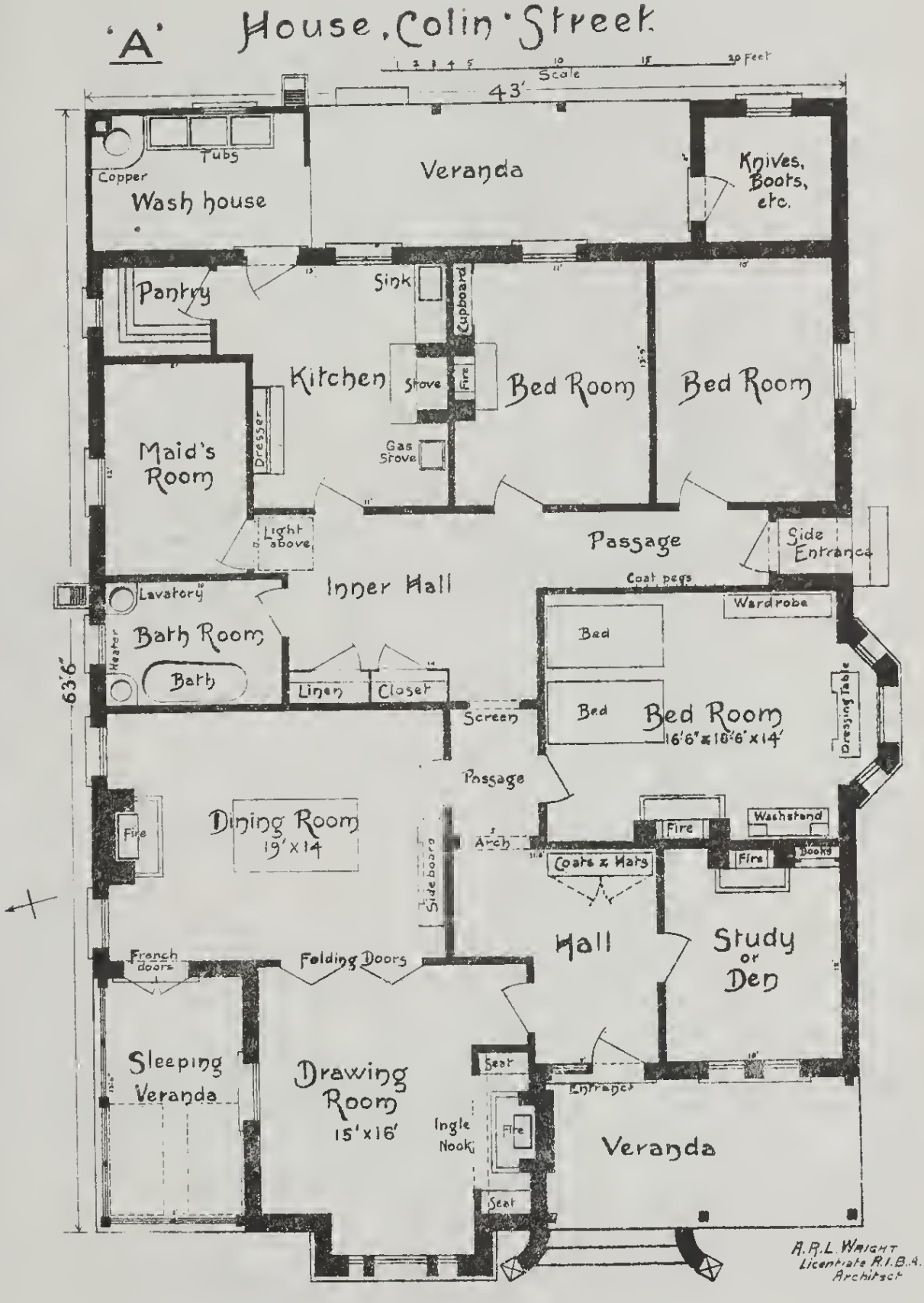
I have already sufficiently animadverted on the use of galvanised iron for roofs, and I extend this objection to fences. No public authority should allow a galvanised iron fence to be erected alongside a street; it is an offence against good taste. Boards or split palings can be used which will tone down with age and produce a homely artistic appearance, and be equally enduring and purposeful.

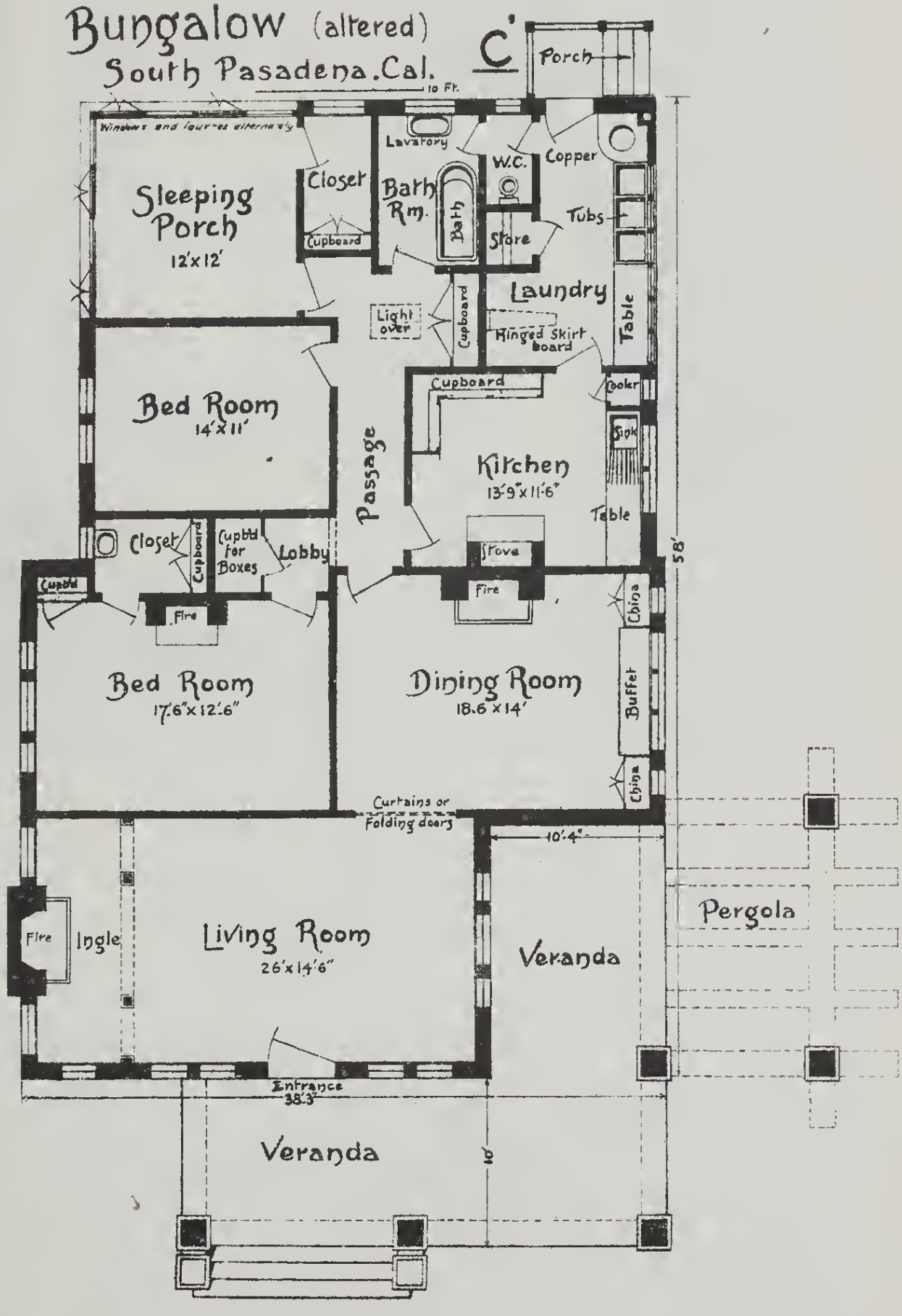
Finally, let householders study landscape gardening, then they will discover how, by comparatively simple arrangement, an ordinary building block can be made a pleasure to themselves and to the general public. It has always struck me as a display of selfishness to hide our gardens behind close hedges. It is the duty of every citizen to assist in improving the town he inhabits and to promote the welfare of his fellow men. Surely if one has been blessed with means to erect a good dwelling with a beautiful garden, one might at least share this pleasure with those who pass by, some of whom may be in less fortunate circumstances. In this respect, Continental, American, and Canadian people put English people to shame. The gardens in front of their houses are visible to everybody and add greatly to the charm of their cities. If I were a town-councillor, I should endeavour to bring in a by-law prohibiting a high close hedge or fence in front of a residence. We should all help to make the City Beautiful and thereby elevate our fellows.

This paper does not pretend to give any instructions, nor to dogmatise in any way. Everyone has his own particular ideas and most of you probably have at one time or another been interested in buildings, but these few remarks will serve as reminders.

The plans shown are simply an indication of the essential features to make a comfortable home, and are all entirely different in arrangement of the various apartments. Being drawn to the same scale, comparison is made easier. One can vary any plan in many different ways, and it is not possible within the scope of this paper to illustrate the exteriors. You can see them in plenty in various publications, also I believe at some drapery or other establishments in the city.

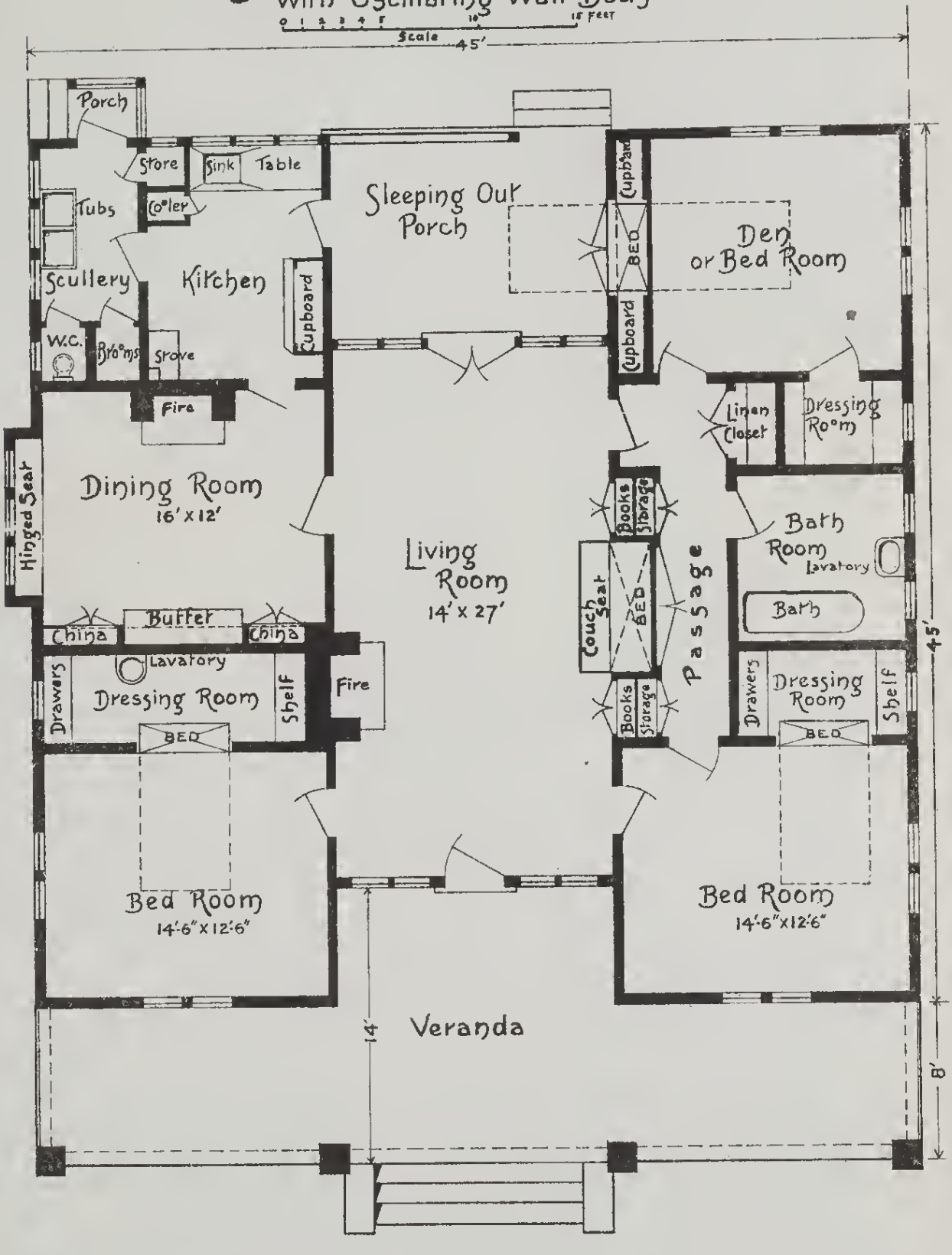

A Suburban House ~ 'B'
E.C.
Fire
Den
10'x8'6"
8'3"
Sleeping Porch
Table
Tubs
Copper
Laundry
Telescope Window
Sink
Table
Bed Room
10'x12'
Fire
Bed Room
12'x12'
Bath
Bath Room
6'x8'
Lavatory
Fire
Kitchen
11'6"x12'
Dresser
Maid's Room
10'x8'
Box Rm
Lobby
Pantry
High Light
Linen
Passage
Cupboard
Lavatory
Dressing Closet
ARCH
Fire
Drawing Room
17'x14'
Curtains
Hall
7'x14'
Folding Doors
Dining Room
15'x15'
Fire
Fire
Bed Room
16'x14'
Telescope Windows
52'
Veranda
10'
Sleeping Porch
58'4"
Scale


'A' House, Colin Street.
Scale
43'
Tubs
Copper
Wash house
Veranda
Knives, Boots, etc.
Pantry
Sink
Cupboard
Kitchen
Stove
Fire
Bed Room
Bed Room
Maid's Room
Dresser
Gas Stove
Light above
Passage
Side Entrance
Inner Hall
Coat pegs
Wardrobe
Lavatory
Bath Room
Heater
Bath
Linen
Closet
Bed
Bed
Bed Room
16'6" x 10'6" x 14'
Dressing Table
Screen
Passage
63'6"
Dining Room
19' x 14
Fire
Arch
Washstand
Fire
Books
Coats & Hats
Fire
Sideboard
Hall
Study or Den
French doors
Folding Doors
Sleeping Veranda
Drawing Room
15' x 16'
Seat
Entrance
Ingle Nook
Fire
Veranda
Seat
A.R.L. Wright
Licentiate R.I.B.A.
Architect


Bungalow (altered)
South Pasadena. Cal.
C'
10 Ft.
Porch
Windows and louvres alternately
Lavatory
W.C.
Copper
Closet
Bath Rm.
Bath
Store
Tubs
Sleeping Porch
12'x12'
Cupboard
Laundry
Light over
Cupboard
Hinged Skirt board
Table
Bed Room
14'x11'
Cupboard
Cooker
Sink
Passage
Kitchen
13'9"x11'6"
Table
Closet
Cupboard
Cupbd for Boxes
Lobby
Stove
Fire
Cupbd
Fire
China
Bed Room
17'6"x12'6"
Dining Room
18.6 x14'
Buffet
China
58'
Curtains or Folding doors
10'4"
Pergola
Fire
Ingle
Living Room
26'x14'6"
Veranda
Entrance
38'3"
Veranda
10'

Suburban House with Oscillating Wall Beds

'D'



In Russia they think anyone is competent to rule the country except an educated man. In Perth the idea is evidently growing that one sells the plans of a house along with a pound of butter. *Such* a house requires a high hedge.

In pre-Victorian days the study of the elements of architecture was included in the curriculum of education of English gentlemen, and there is no reason why it should not be a subject included in a liberal education.

The study and practice of domestic architecture is also very suitable for young women of refined taste with artistic proclivities. In some countries women have attained a high degree of efficiency in this career. In New Zealand, Queensland, and New South Wales, and in England and America, there are female members of the architectural institutes.

I should be pleased to see some girls adopt this section of the profession in Western Australia. The selfish and exploded notion that they would be intruding in a man's domain may be put to one side.

DESCRIPTIVE NOTES ON PLANS.

Plan A.—A town house for a professional man. The bedrooms are away from the front, and the bathroom and kitchen are well placed. The side entrance is convenient. The sleeping porch is enclosed above dado with opening sashes. The inner hall is a room and not merely a passage. Every occupant has commended this house. E.C. attached to woodshed, not shown.

Plan B.—Plan by a Sydney architect, with many alterations. Suitable for a wide frontage. Similar accommodation to "A." The drawing room, hall, and dining room can be thrown into one for dancing. The back sleeping porch is approached through bedroom and bath-room. Attached E.C.

Plan C.—Californian house plan altered to suit W.A. Entrance through living room, and little passage area. Dining and living room with verandah give ample dancing-room. Front side verandah can be used for sleeping if required. Inside W.C. for sewerage system. An economical plan.

Plan D.—A Sydney plan with central living room and bedrooms fitted with oscillating portal wall-beds which fold into well ventilated compartments in the daytime, and allow the rooms to be used as sewing-room, etc. All the bedroom equipment is in the dressing rooms. The plan is complete if ordinary beds are used. House is economically planned. Inside W.C. for sewerage system, or it can be outside.

These plans are all different from those one usually sees and illustrate points in this paper, but they are not given as models of perfect plans. Every house requires its own individual design to suit the purpose, locality, and expenditure. A house should be an architectural building, and not a mere structure.

THE WESTERN AUSTRALIAN CHRISTMAS TREE.

NUYTSIA FLORIBUNDA (THE CHRISTMAS TREE)—ITS STRUCTURE AND PARASITISM.

By D. A. Herbert, B.Sc., Economic Botanist and Plant Pathologist to the Western Australian Government.

(*Read 8th April*, 1919.)

Nuytsia floribunda, the Christmas Tree, is perhaps the most interesting member of the flora of Western Australia. It is confined to the South-Western division of the State, being found from the Murchison River round to Esperance. The tree finally reaches the height of 30-35 feet, and frequently two or more trunks arise together. At Christmas time the tree is a brilliant blaze of orange flowers, which are borne on dense racemes at the ends of the branches. The immense development of flowers is all the more remarkable since so few fertile seeds develop. Many trees do not develop a single seed; others may develop a number—a very small number in comparison with the tremendous number of flowers—but very few of these are fertile. Whether fertile seeds will produce mature plants is a question which will be discussed later in this paper.

The failure of the tree to produce much seed may be the direct result of the large production of blossom. A great deal of stored food material is used up in the flowering period and in Nuytsia where blossom is so abundant the resources are too much depleted to provide enough food material for the maturing of the fruits. This is borne out by the condition of the mucilage in the plant before and after flowering. Before flowering the mucilage canals are full of a milky fluid in such quantity that quite a large amount is exuded when a root or branch is broken or cut. This rapidly coagulates and blackens on exposure to air. It is very palatable to some animals, especially pigs, which root up the roots for yards if they are close to the surface. During the flowering period it decreases rapidly in amount and loses its milkiness, until at the period when the tree should be fruiting the exudation from a broken root or branch is almost nil.

That this non-production of fruit is probably due to the large amount of blossom formed is also borne out by the fact that the same phenomenon occurs in the case of cultivated trees, such as the apple and the pear. Very frequently such trees have a tremendous development of blossom which results in hardly a single

fruit. Thinning out of the blossoms results in the production of a good yield of fruits for two reasons—firstly there are fewer fruits to be supplied with food material, and secondly a great deal of energy has been saved by the loss of the thinned-out blossoms.

STRUCTURE.

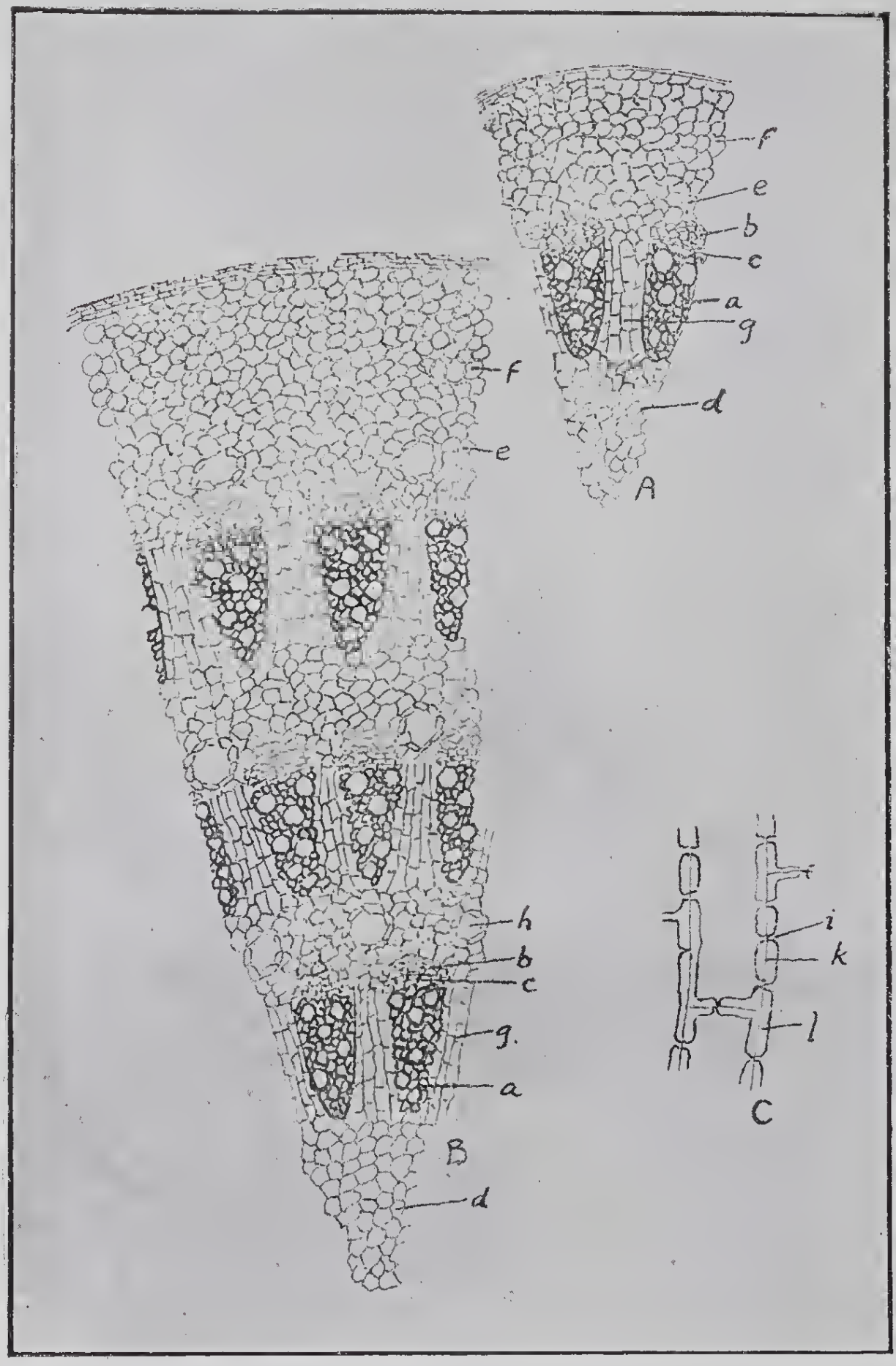
On digging down it is found that long underground stems run out from the Christmas Tree, sometimes for great distances (one at Como was traced for 120 yards), and giving off aerial branches having the appearance of trees at intervals along their length. Small plants, which might be taken for seedlings, are frequently found in belts of country where the Christmas Tree is common and almost invariably these are found to be suckers from this long stem. The production of suckers explains why Nuytsia is so common throughout the South-West in spite of its extremely small production of fertile seeds.

The growth of the stem is peculiar both microscopically and macroscopically, the second peculiarity following from the first. A very noticeable character is the extreme brittleness of the branches and roots, quite thick members snapping under quite a small pressure. This is not the case with the young twigs of one year's growth. It only takes place after secondary growth, and the explanation lies in the unusual and remarkable method of secondary growth of the tree. This is similar in both stem and root, when allowance has been made for their difference in primary structure.

In transverse section the young stem is quite normal. (Fig. 1. (A).)

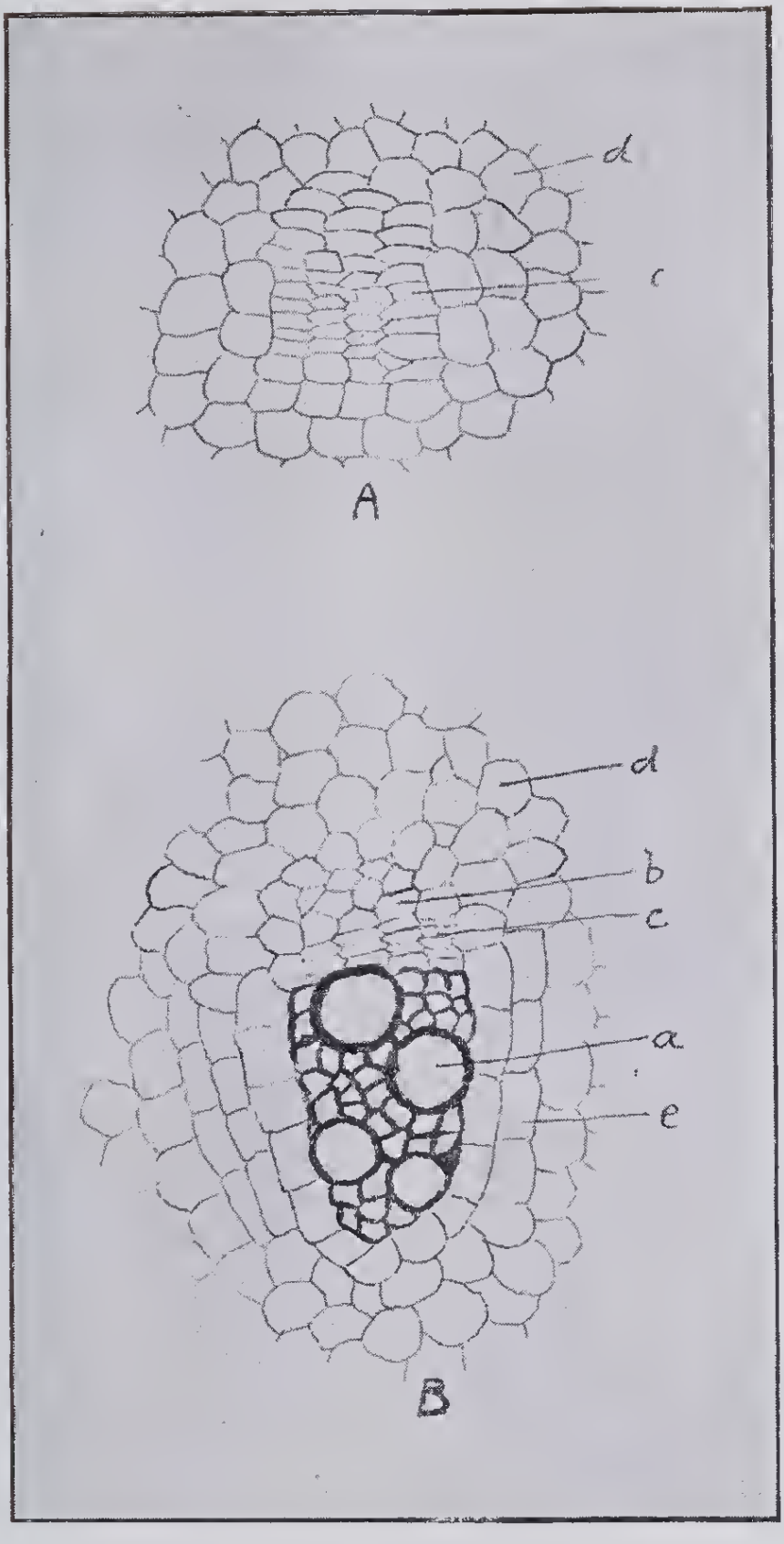
The central zone of pith is surrounded by the vascular bundles and these again by the cortex. In the normal dicotyledonous stem the cambium between the xylem and phloem elements divides forming xylem elements on the inner side and phloem elements on the outer side. In this way a cylinder of wood surrounded by phloem and cortex is produced. In the Christmas Tree the mode of growth is at first normal. There is a meristematic layer between wood and phloem of the primary bundles and this divides until they have reached a certain size, when it loses its function and a new cambium is formed in the thin-walled cells of the inner cortex. This cambium is not continuous round the stem but occurs in patches several cells in width. The cortex is divided into two fairly definite layers, the cells of the inner layer being thinner-walled and its cells smaller and more compact than those of the outer. When the new cambium is formed, several of these cells start to divide at different points round the stem forming typical cambium cells.

Fig. 1.



A. Young stem.
B. Old stem showing three rings of bundles.
C. Medullary Ray.
a, xylem; b, phloem; c, cambium; d, pith; e, inner cortex; f, outer cortex; g, interrupted medullary ray; h, mucilage canal; i, pore;

Fig. 2

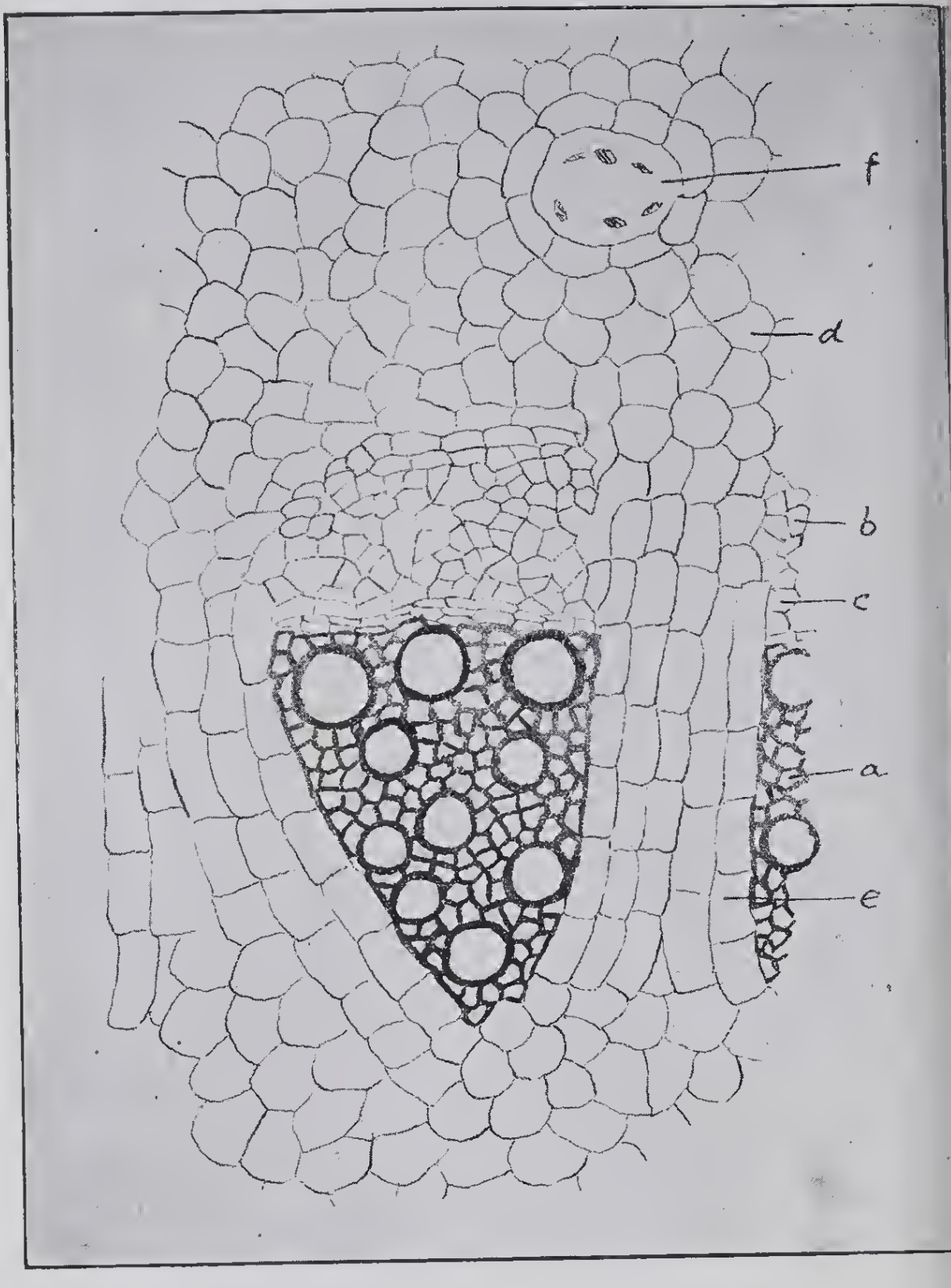


A. Cambium formed from thin walled cells of inner cortex.

B. Later stage in development of the bundle. Xylem and phloem elements have been formed from the cambium.

a, xylem; b, phloem; c, cambium; d, inner cortex; e, medullary ray.

Fig. 3.



Bundle, medullary rays and mucilage canal.
a, xylem; b, c, phloem; d, cells of inner cortex; e, medullary ray; f, mucilage canal showing proteid bodies in the mucilage.

By repeated division phloem cells are cut off from these dividing cells on the outer side and xylem on the inner side (Fig. 2B). This cambium continues to grow to a certain stage when it, too, loses its power of further division and another set of new cambiums is formed out in the inner cortex in a similar manner to that described above. This is repeated continually so that successive rings of vascular bundles separated by thin-walled cortical tissue are produced (Fig. 1B).

Short medullary rays run between the collateral bundles but these are only the length of the xylem and rarely any longer. They do not run through the cortical tissue and connect with the medullary rays of the next ring. The walls of the medullary rays are pitted (Fig. 1C). Pits are often found in the walls of the cortical and the pith cells as well as in the medullary rays. Viscum, another member of the family, also has cortical cells with pitted walls through which there is protoplasmic connection between adjacent cells.

Mucilage canals traverse stems, roots, and leaves. They are formed by breaking down of long rows of cells. In the young stem there is one canal in the pith. As the stem grows older more of these appear in the pith and in the inner cortex. When new layers of cambium are formed in the cortex these are always outside the mucilage canals so that canals are found in the cortical tissue between the successive rows of bundles. A canal less definite in structure runs along the posterior side of the bundle of the leaf.

This peculiarity in the internal structure of the stem is also responsible for the strange macroscopic appearance of the Christmas Tree

The young branch is at first upright, but as it increases in thickness it takes on a downward curve until the angle becomes too steep, when it ceases growth and another branch further back takes its place and continues the growth until it, too, becomes too steeply curved, when another branch takes its place. The portion of the branch below the end and the new main branch generally dies back. This strange mode of growth is responsible for the characteristic rugged appearance of Nuytsia. No such curvature is found before secondary growth has taken place and curvature is not due to a more rapid growth on the upper side of the stem. Branches of three or four years' growth because of their peculiar internal structure are very easily bent under comparatively light pressure, and the weight of the leaves and blossoms (that of the latter being very considerable) causes the gradual downward curvature.

The secondary growth of the root is of essentially the same character as that of the stem, though differing a little because of

the normal structural difference of stem and root. Like the young stem, the young root is normal in structure (Fig. 5) and may be diarch or triarch.

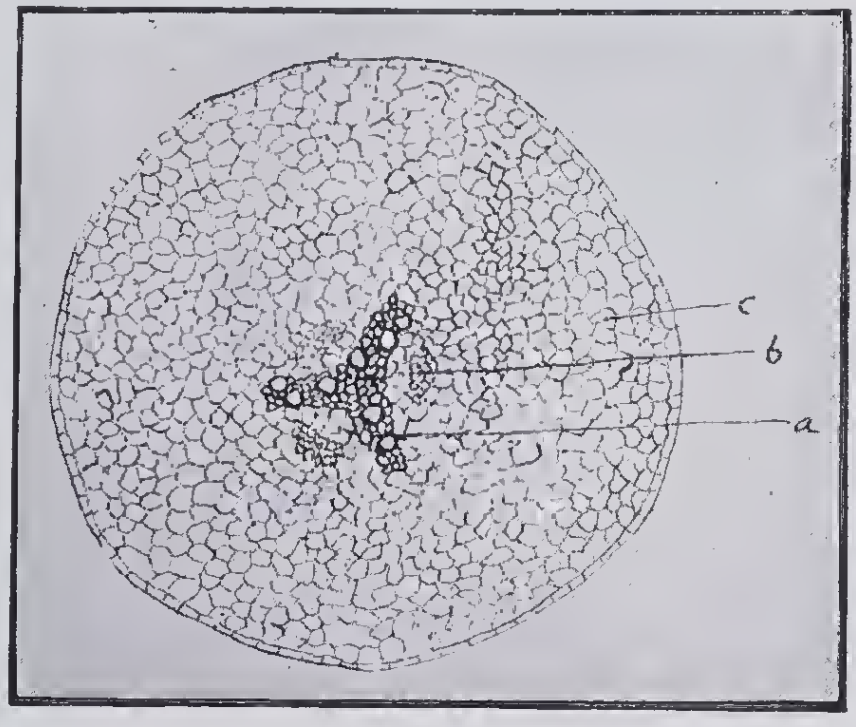
Fig. 4.

Christmas Tree, showing downward bending in the branches.

Here again the cambium between wood and phloem divides to a certain extent forming secondary elements, but soon loses its function, and new patches of cambium are developed out in the

inner cortex. The xylem of the elements formed from these second cambiums connects with the central xylem strands (which consist

Fig. 5.



Young root of Christmas Tree.
a, xylem; b, phloem; c, cortex.

of the primary and a certain amount of secondary wood) so that the protoxylems are surrounded by later formed wood elements (Fig. 6).

When this second ring of cambium patches has divided to a certain extent it ceases to divide and another new cambium is formed outside in the inner cortex. The bundles formed from this are not connected with the previous year's bundles, but are separated, as in the stem, by a layer of cortical tissue. All further growth in thickness after this is similar to that in the stem. The result of this method of growth is that the old root shares the stem's characteristic of brittleness. Mucilage canals and interrupted medullary rays occur here as in the stem.

PARASITISM.

Nuytsia floribunda is the sole representative of its genus. It is classified systematically with the Loranthaceae,* and on account of this its autonomy has long been questioned, though no definite evidence was brought forward.

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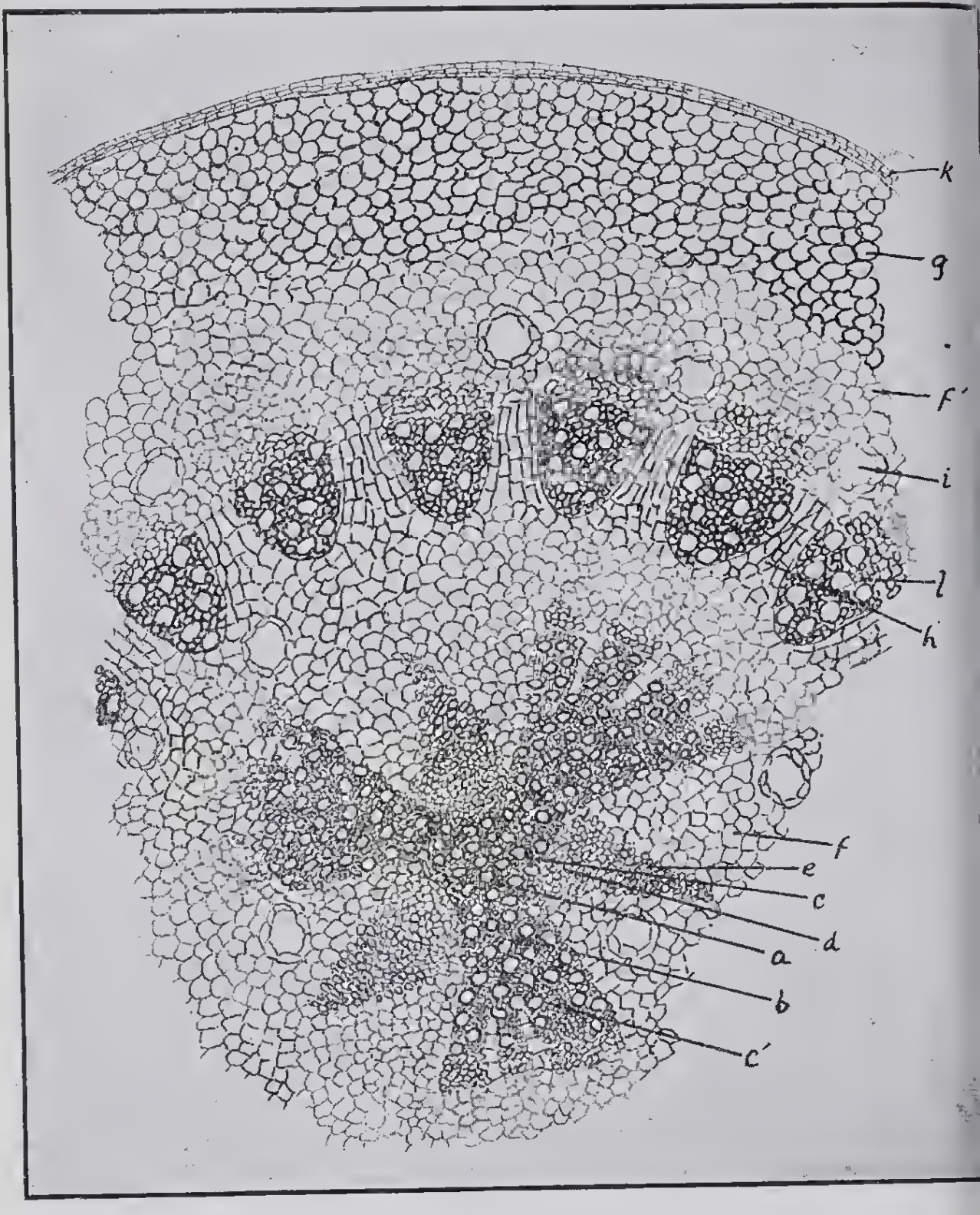
* See end of paper, p. 88.

Fig. 6.



Old root of Christmas Tree.

a, position of primary xylem (see Fig. 5); b, protoxylem; c, secondary wood added to primary xylems by a certain amount of division of the cambium; c′, secondary xylem formed from cambium formed from inner cortex; d, phloem; e, sclerenchymatous strand external to primary phloems; f, f′, inner cortex; g, outer cortex; h, medullary ray; i, mucilage canal; k, cork; l, bundles formed by the second cambiums formed in the outer cortex.

The tree is frequently in places where parasitism would seem unlikely. Dr. Diels, on finding it growing on barren and healthy sand-scrub, the solitary tree for miles round, considered it a far-fetched assumption that the tree would draw on the dwarf bushes at its base for nourishment, and concluded "Till some counter evidence is produced we must adhere to the autonomy of Nuytsia floribunda."

Mr. W. Webb, of King George's Sound, furnished some notes on Nuytsia floribunda in response to some questions asked by Baron von Mueller and these were published in the *Victorian Field Naturalist* in 1894. They are brief and may be given in full:—

> We can find thousands of what at first sight appear to be seedlings but on tracing the roots we always find them growing from the roots† of parent trees, and therefore we think these supposed seedlings are nothing more or less than suckers. Up to the present we have not been able to find the roots attached to anything; they shoot in all directions and for great distances but never penetrate the soil deeply, but are always found some few inches below the surface. In this manner they may and probably do receive their sustenance from decaying vegetable matter, such as the roots of numerous species of shrubs amongst which Nuytsia usually grows. As this plant has a pretty wide range in West Australia, would it be worth while to ascertain what trees and shrubs occur in every locality where Nuytsia is found? So far as my memory serves me, I feel certain that a great difference will be found in the species of plant life at different places. My own opinion is that Nuytsia is an independent tree and it requires certain conditions in the soil which can only be given to it by certain other species of plants. However, I have nothing to advance in proof of the above except that I have never found the roots attached to the roots of any other plants.

Harvey (Hooker's Journal of Botany VI., 219) thought it highly probable that there was connection between the roots but could offer no proof. Dr. Morrison apparently made some investigations according to a reference by Diels, but I have been unable to find a record of his work. In the Western Australian Year Book, 1902-1904, however, he refers to Nuytsia floribunda as "a non-parasitic tree of the Mistletoe family." It would appear, therefore, that authorities up to the present, while suspecting the parasitic nature of the plant, have had to admit the absence of definite proof, and in some cases they have finally concluded that the Christmas Tree is independent.

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† The roots referred to are really stems. D.A.H.

Figs. 7 and 9.

Figure 7.—Commencement of attack on Christmas Tree root on root of Jacksonia furcellata, showing the two fleshy arms commencing to surround the root.

Figure 9.—Haustoriogen on a larger root (Melaleuca viminea). Part of the root has broken off, giving the haustoriogen the appearance of being the end of the small root.

There is nothing in the appearance of the tree to suggest a parasitic mode of nutrition. The leaves seem quite capable of supplying the organic food material necessary, as they are not deficient in chlorophyll, while the roots appear quite capable of supplying the mineral constituents necessary.

Roots are given off from the long underground stems and when they are traced out they are found to branch repeatedly, finally giving rise to long white fleshy roots up to about a quarter of an inch in diameter, and from these branch smaller white and very fragile roots. It is probably on account of the extremely fragile nature of these roots that the parasitic nature of the Christmas Tree has not actually been discovered previously. When they come into contact with another root, a fleshy outgrowth starts to develop. Two white fleshy arms start to grow round the attacked root in opposite directions from the point of contact (Fig. 7).

Ultimately the two arms meet on the other side of the root and fuse so that an unbroken fleshy ring encircles the host (Figs. 8 and 9).

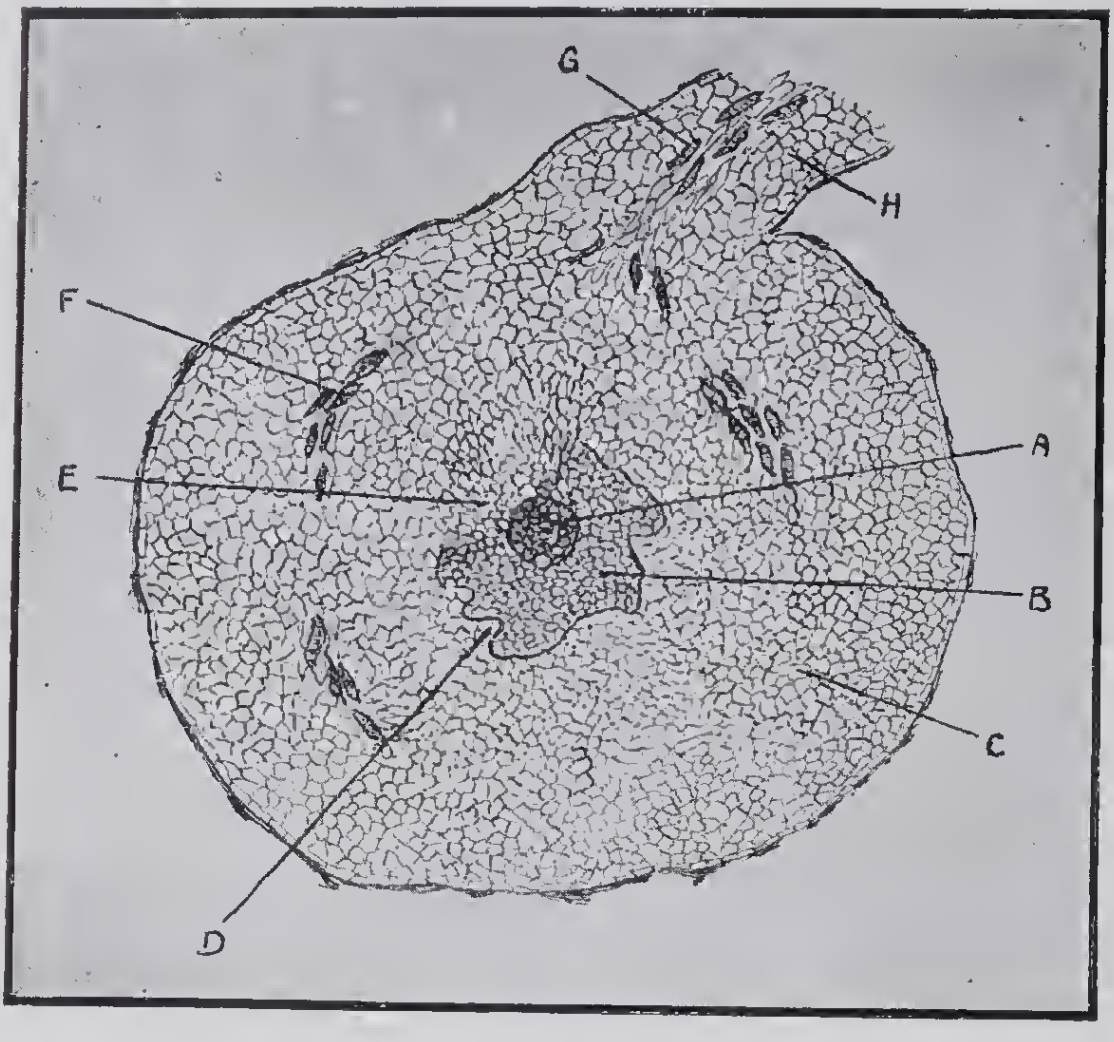
Fig. 8.

Haustoriogen on young root of Hibbertia hypericoides.

On the inner side of this fleshy ring, at the points of contact, arise the haustoria or suckers, so that it may for convenience be called the haustoriogen (Fig. 10). The haustoria are formed on the inner side of the fleshy arms before the ring is complete. The haustoriogen in section is found to contain a very small vascular bundle, which goes right round; but the greater part of it is composed of simple parenchymatous tissue. The haustoria are small tongue-like masses of parenchymatous tissue, and when they pierce

the cortex of the host plant they appear to derive all food materials they obtain from it by simple osmosis. There is no fusion of the cells of host and parasite. The haustoria never go in as far as the wood. The wood is the channel of transference of water containing the organic constituents of plant life and the cortex and bast the means of transference of elaborated nitrogenous and non-nitrogenous organic food materials. The conclusion is that the main object of the parasitism of Nuytsia is to obtain an additional supply of organic materials, including nitrogenous substances.

Fig. 10.



Transverse section of haustoriogen attacking a root of Hibbertia hypericoides.

a, wood of host; b, cortex of host root; c, cortex of haustoriogen; d, haustorium in early stages of attack; e, haustorium in complete contact with cortical cells of host root; f, indications of vascular bundle of the haustoriogen; g, part of vascular bundle entering haustoriogen; h, cortex of root from which the haustoriogen has arisen.

In contrast to this is Nuytsia's close relation, Loranthus the Mistletoe. Here we have a plant parasitic for water and salts and quite well able to provide all the organic food materials it needs.

In this case there is vascular connection between host and parasite. It has been said that the Mistletoe may be more symbiotic than parasitic when it is on deciduous trees because it is evergreen and assimilates carbon dioxide in the winter when the host tree is leafless. The greatly decreased fruit crop in attacked apple trees proves that any symbiosis is greatly outweighed by the parasitism of the mistletoe. A more complete state of parasitism is shown by Cassytha, the Bush Dodder, which is common throughout Australia. This is a twining plant with green leafless stems. From the point of contact of its stem with the host arise haustoria. Here again there is vascular connection between host and parasite, the woods and phloems of each uniting. Cassytha is parasitic for both organic food materials and transpiration water containing inorganic salts. Both the Mistletoe and Bush Dodder are aerial parasites. The natural order Rhinanthaceae is notorious for the number of root parasites amongst its members. These, like Nuytsia, appear to have quite enough leaves to supply all the organic material necessary, but nevertheless need root connection to enable them to reach maturity. Their root system connects with that of the host root by means of disc-shaped haustoria. The fleshy ring giving rise to haustoria, as found in the Christmas Tree, is unique. The seeds of Orobanche, the Broomrape, another exotic root parasite, will only germinate when in contact with the roots of a host plant. This is certainly not the case with Nuytsia, the seeds of which will germinate out of contact with any host root.

Seedlings are very rare and generally die off young. The survivors owe their success to having obtained connection with a host root early, while early death is often due to the failure of the root to find a host and the failure of the leaves to provide all the organic food materials necessary. One seedling at Mount Lawley was found to be drawing on the stem of the couch grass (Cynodon dactylon). This is interesting because it goes to show that the parasitic attacks of Nuytsia are not limited to roots. Seedlings may readily be distinguished from suckers by their stems, leaves, and rate of growth. The sucker appears above the ground as a stem about a quarter of an inch thick and grows rapidly so that in a year it is about four (4) feet high. Its pale leaves are few and sparsely scattered. A seedling, on the other hand, has a much thinner stem more closely beset with leaves, which are a brighter green than those of the sucker. One would expect the seedling to have more leaves and for these to contain more chlorophyll because it is more dependent on its own resources than is the sucker which has the reserve food material of the parent underground stem to draw on. The growth of the seedling is also much slower, a year-old seedling being several inches only in height and this is attributable to the same cause. Numerous

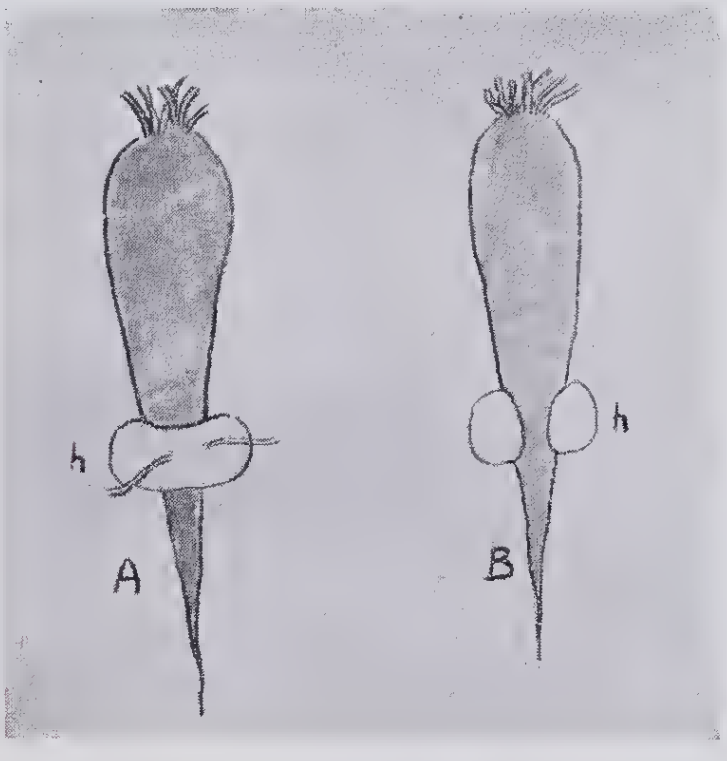
attempts to raise seedlings of the Christmas Tree have been made but up to the present all have failed. The nature of the parasitism of the tree suggests a method of raising it successfully—the planting of the seed in a spot where its roots when formed will have easy access to the young roots of a plant which has been proved to be a host.

The haustoriogen is not the end of the Christmas Tree root. It is a lateral growth. The root continues to push its way through the soil to look for fresh victims. If it comes into contact with a large root it may run along the large host giving rise to a number of these parasitic outgrowths. Where the fleshy ring is developed round a root it grows in size but not in internal diameter, so that as the host root itself grows the haustoriogen acts as a ligature and gradually strangles it. It is a common thing to find a host root ending abruptly in the fleshy haustoriogen of the Christmas Tree, because the lower part, being strangled and starved, has died and rotted away. Sometimes a root attempts to ward off the attacks of the Nuytsia root by the development of cork and in some cases is successful in preventing the entry of the haustoria. If, however, the root is a small one, the haustoriogen ring may be formed just the same even though the haustoria cannot gain entrance, and the root is strangled by the ligature in time.

In its choice of hosts Nuytsia is very cosmopolitan. It attacks herbs, shrubs, and trees impartially. Exotics and natives, annuals, biennials and perennials, monocotyledons and dicotyledons are treated alike. I have found it attacking geraniums, roses, carrots, broad beans, black nightshade, sorrel (Rumex acetosella), couch grass, the so-called tree lucerne (Cytisus prolifera var. alba), vines, oranges, Hibbertia hypericoides, Banksia attenuata, Banksia Menziesii, Stirlingia latifolia, Melaleuca huegelii, Melaleuca viminea, Conostephium pendulum, Jacksonia furcellata, Calythrix flavescens, and Acacia pulchella. Further search will probably reveal it on a great many more species. Sometimes in its searchings for a host the Christmas Tree root comes into contact with another Christmas Tree root and attacks it in the same way that it would an ordinary root, but this is rare. It is analagous with the self-attack frequently noticed in such climbing parasites as Cassytha, the Bush Dodder, which nearly always recoils on and parasitises itself at some point or other. Very often the attack of the Christmas Tree is so strenuous that the host plant is starved and killed, in which case the fragile root which has given rise to the haustoriogen shrivels away, leaving the fleshy haustoriogen attached to the dead host root with hardly any sign of ever having had any connection. It looks at first sight like a fungal body, but a section shows its true nature by revealing the vascular tissue and the haustoria.

The haustoriogens are formed along the whole length of the underground stems and this accounts for their long life in the soil when the aerial parts have been removed. They can obtain all the organic and inorganic food materials they need without assistance of aerial shoots. Sometimes this underground stem can be traced along by the line of dead, dying, and weakened plants. In other cases the attack seems to cause the host plants very little inconvenience. The number of the roots affected is, of course, the deciding factor as to whether the plant will suffer or not. Sometimes nearly every root is surrounded by the haustoriogens of Nuytsia. At Como this is the case with banksias, ti-trees (Melaleuca viminea), and numerous other plants, both shrubs and herbs, many of which have been killed.

Fig. 11.



Carrots attacked by the haustoriogen of Nuytsia.
A, appearance of attacked carrot.
B, vertical section of same showing ligature effect of haustoriogen. h, the haustoriogen.

The rapidity of growth of the haustoriogen was shown in the case of the attack on some carrots at Como. These when only half-grown started to die off and on digging down it was found that the roots were surrounded by well-developed haustoriogens over half an inch in diameter (Fig. 11). The rapidity of develop-

ment of these coupled with the large number produced along the length of the underground stems shows that Nuytsia is able to obtain a large amount of food materials from annuals and other small plants when growing as the solitary tree in a pasture.

Dr. Diels* is inclined to regard Nuytsia as being distinct from the Loranthaceæ and rather belonging to the common family from which both the Loranthaceæ and Proteaceæ have sprung. He summarises his objections as follows:—

> It (Nuytsia) cannot truly be said to belong to the real Loranthaceæ because of its fruit, and its habits remind one more of the Grevilleoidæ.

The difference of fruit does not seem sufficient reason for separating it from the family to which it is assigned, greater differences of fruit being shown in other families and which are regarded as generic and not ordinal. The flower is six-partite (the typical Proteaceæ have four (4) perianth segments), and is that of a Loranthus; in fact Labillardiere called the tree Loranthus floribundus.

With regard to habit, this is typically Loranthaceous in many points. Parasitism is characteristic of the family, and the discovery of this adds another link between Nuytsia and the other members. The leaves are very similar in their form and fleshiness, and the twigs of the Christmas Tree are very similar to that of Loranthus celastroides in appearance.

The underground stem may be compared with a similar structure in the mistletoe. The best investigated species of mistletoe is Viscum album, a European plant. The seeds germinate on a host plant; a sucker penetrates into the cortical tissues and bast and then stops. Subsequent growth of the branch results in the embedding of this sucker in the later-formed wood so that it appears to have pierced the wood. Lateral roots are given off and run along the cortex in both directions. At intervals along this cortical root arise aerial shoots; from the other side more sinkers go in as far as the wood, and further growth results in their being imbedded in the host wood also. This cortical root is analagous with the long underground stem of Nuytsia and shows similarity in habit of the two plants, when allowance has been made for the fact that Nuytsia is a terrestrial root parasite and that the mistletoe is parasitic on branches only. The conclusion is, therefore, that the structure and habits of the Christmas Tree are in accordance with its systematic placing in the Loranthaceæ.

* Pflanzenvelt von W.A., 1906.

LIGHT AND THE ETHER.

By Professor A. D. Ross, M.A., D.Sc., F.R.A.S., F.R.S.E.

(*Read 13th May*, 1919.)

The wave theory of light was advanced by Huyghens towards the close of the 17th century. It gradually superseded the emission or corpuscular theory which had been held by Newton, but which was at variance with the fact that the velocity of light is greater in air than in denser media such as water and glass. The medium in which the light waves take place on Huyghen's theory is termed the aether—a subtle fluid which permeates all space. And since the velocity of light in air is the same as that of an electromagnetic wave in air, it is concluded that light itself is an electromagnetic wave. This conclusion has been generally accepted as the result of Hertz's experiments and Clerk-Maxwell's mathematical investigations.

The velocity of light has been determined in a variety of ways:—1. From Römer's observations of the acceleration and retardation of the times of occurrence of eclipses of Jupiter's satellites depending upon the varying distance of the Earth from Jupiter. 2. From Bradley's investigation of the aberration of light—light appearing to come from a direction slightly different from the true direction in consequence of the Earth's motion (the effect is strictly analagous to the phenomenon of vertically falling rain appearing to come obliquely from in front against a person moving through it). 3. From experiments by Foucault, Fizeau, Forbes, and others on the time taken by light to travel over a measured distance not exceeding a few miles.

In Bradley's investigations of the aberration of light, it was shown that a telescope used in observing a star was always slightly inclined to the true direction of the star by an amount depending upon the ratio of the Earth's velocity to the velocity of light. The theory assumed that the aether was at rest while the observing telescope and the contained air moved through it. As the experiment gave a result in harmony with those of other methods, this assumption was evidently justified. Airy, however, repeated Bradley's experiment with the telescope filled with water. Since light travels in water with only three-fourths of its velocity in air, the aberration should have been correspondingly greater. It was found, however, to be quite unaltered. Apparently, then, air moves freely through the aether, but water drags the aether along. Fresnel made a mathematical investigation of this aether drift, and his resulting formula was afterwards verified by an ingenious

experiment due to Fizeau, in which two rays of light were sent along the same path, one with and one against a stream of water, that is, one with and one against the resulting aether drift.

If V is the speed at which a swimmer travels through the water of a river flowing at velocity v, then the swimmer will be able to travel up, down, and straight across the river at speeds which are respectively $(V - v)$, $(V + v)$, and $\sqrt{(V^2 - v^2)}$. Hence if the river is of width s, the time T_1 taken to swim across and back is $2s/\sqrt{(V^2 - v^2)}$, and the time T_2 to swim distance s up or down the river and back is $2Vs/(V^2 - v^2)$. That is, we have

$$T_1 : T_2 :: V : \sqrt{(V^2 - v^2)}.$$

But V is greater than $\sqrt{(V^2 - v^2)}$ for all possible values of V and v, and thus the time for a certain journey up and down stream is always greater than for the same length of journey across stream. For example, a person who swims 2 miles per hour will take less than 3 mins. 28 secs. to cross and re-cross a river four chains wide flowing at one mile per hour. He will, however, take 4 mins. to do the same length of double journey up and down the river.

Now, as the Earth is moving relatively to the Sun, and the Sun relatively to other members of the sidereal universe, our Earth is evidently in general travelling through the aether, or, the aether has a drift relative to the Earth. And for light travelling at velocity V through an aether drift of magnitude v, the time for the double journey along the line of aether drift must be greater than the time for a path of equal length at right angles to, that is athwart, the aether drift. Michelson and Morley attempted to test this by experiment. They sent a ray of light along a certain path and reflected it back to the point from which it set out. Another ray was sent an equal distance along a path at right angles, and any minute difference in the times taken by the two rays to return could be easily ascertained by a delicate interference test. The two rays were found to take precisely the same time. As this was contrary to theory, it was clear that the path which was across the aether drift must really have been longer than the path which lay along the aether drift. Now these paths were along rigid iron arms attached to a vertical stand floating in mercury. The apparatus could thus be rotated through a right angle so that the path which formerly was along the aether drift was now across it, and vice versa. But on repeating the experiment in this new position there was found again to be no difference in the times taken by the rays to cover the two paths. Only one conclusion appears possible—the rigid arms altered in length, shortening when turned into the direction of the aether drift and lengthening when turned at right angles to it! Remarkable as is this conclusion, there is no escape from it, and scientists now accept the fact that our standards of length—the standard yard

kept in London and Borda's standard metre—change in length from time to time as the Earth changes its direction of motion through space and through the aether, or as these bars are turned about in the laboratories in which they are kept. We have no means of measuring our speed relative to the aether. For all we know to the contrary our Earth may at the present instant have a speed of, say, 100,000 miles per second relative to the aether. If it has this velocity, then a man who is 5ft. 8in. high when he stands up at right angles to this relative motion will be only 4ft. 9in. in height when he lies in the direction of the motion. We could not tell this difference by the eye, because the retina of our eye would have undergone a similar contraction in the same direction and the image of the 4ft. 9in. man would cover the same proportion of the retina in that direction as the image of the 5ft. 8in. man would cover in the other direction. We fail to observe this actual change which takes place in the dimensions of what we call rigid bodies, not because it is possibly small (it may be great as a matter of fact), but because it is of such a character as to baffle all ordinary tests, although it is revealed indirectly by such peculiarly applied tests as the Michelson-Morley experiment. The change will not appear just so difficult for us to admit when we remember that in all probability the forces of cohesion which bind together a rigid body are of the nature of electrical forces and thus act through the aether with its drift relative to the rigid body.

We commonly speak of space as having three dimensions, the directions which we popularly term up-and-down, to-and-fro, right-and-left. We can, however, imagine a flat or two-dimensional universe inhabited by flat beings who would fail to realise what was meant by the third dimension of up-and-down. And mathematicians find it just as easy to make calculations for four dimensions as for only three. It is possible for us, therefore, to imagine a model (we cannot actually construct it) which would introduce a fourth dimension. In a two-dimensional diagram we can show in a graph how the lengths and widths of rectangles of the same shape as this page are connected. In a three-dimensional model we could show how the lengths, breadths, and thicknesses of books of similar shape to this volume are connected. And in a four-dimensional model we could show in the same way how the lengths, breadths, and thicknesses of the volumes of Proceedings of this Society had varied at different times. The mathematician can, therefore, picture a model in which are indicated by distances in four directions, mutually at right angles, what we may call length, breadth, height, and (say) time. But owing to the curvature of the surface of our spherical Earth, the direction which we call in Perth purely height is a direction in space which is equivalent partly to height and partly to (say) breadth in Sydney, and equivalent partly to height and partly to (say) length in Roe-

bourne.* Now Minkowski has used the fourth dimension of the nature of time as being of the same essential character as the others, and so while what we happen to regard as purely height in Perth may be regarded as purely breadth in Cape Colony, it might be regarded as of the nature of time in some other world possessing a velocity different from that of our Earth. The four-dimensional construction is very convenient as connecting together what we term position (or space) and time, so that a graph in it gives the whole history of progress of a particle in our universe, what we term the "world-line" of the particle. This four-dimensional world is spoken of as Minkowski's space-time world, and we gather from it that it is impossible to obtain an absolute separation into space and into time, but only a relative separation made to suit the particular observer. In Minkowski's own words, "Henceforth space and time in themselves vanish into shadows, and only a kind of union of the two preserves an independent existence." This idea is referred to as the principle of relativity, and we picture the aether as a four-dimensional continuum filling uniformly Minkowski's space-time world. In short the position is this, that just as we have regarded such properties as the colour and scent of a rose as dependent on the acuteness and accuracy of the observer's senses of sight and smell, so we must regard all ideas of form, position and time as purely relative and as varying for observers on different worlds having different motions relative to the aether. Time is no more absolute than our ideas of taste, touch, smell, colour and sound.

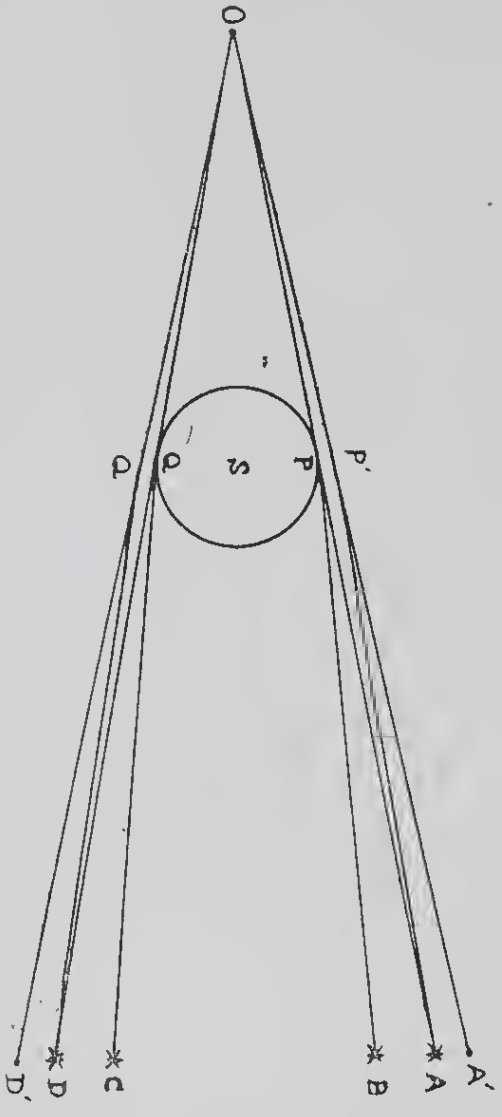
All observation consists in the recording of coincidences. For example, in measuring the size of a microscopic object we note the coincidence of the ends of the object with two lines on two scale divisions in a micrometer eyepiece. Hence as the world-line of a particle gives its full history, observations are merely the discovery of intersections of these world-lines, and we know of the action of a force on a particle by the deflection produced in the world-line of the particle. When there is no external action, the world-line runs straight. The gravitational influence of a particle throughout its neighbourhood, which leads to it affecting other particles and deviating their world-lines, has been accounted for on a theory which, while it in no way explains the cause of gravitation, brings that action for the first time under the same rationale as other forces. It is assumed that the gravitational field surrounding a particle is equivalent to a strain or distortion of that portion of Minkowski's space-time world, and that the orbit due to gravitational action of a second particle about the first is a path

* In mathematical language, a vector which is parallel to the vertical axis OZ for Perth, has components along the vertical axis OZ and the horizontal axis OY at Sydney, and components along the axes OZ and OX for Roebourne.

through the distorted medium which would be straight if the distortion were removed. Einstein has found that on this theory a modification is necessary in Newton's law of gravitation. One form of Newton's law is that expressed in Laplace's potential function, but this form cannot be applied to such a force as centrifugal force. To get uniformity of treatment of all varieties of force a modification is needed of the gravitational law from the statement as originally given by Newton. Einstein has put forward a modified law which is indistinguishable from Newton's law in its effects in all but a few crucial tests: that is to say, the modification has not upset in the slightest any of our customary deductions from the old form of the law of gravitation. On the other hand, using the old form of the law the motion of that point of the planet Mercury's elliptical orbit round the Sun which lies nearest to the Sun was calculated to undergo a movement of 8 minutes 52 seconds of arc per century. Observation, however, showed the movement to be at the rate of 9 minutes 34 seconds, and Einstein's modification of the gravitational law has altered the calculated value to 9 minutes 35 seconds. Briefly put, Einstein's theory has not upset one of the innumerable cases where the old law was in agreement with fact; it has brought agreement in one case (that of Mercury) where grave discrepancy existed, and in at least one case it has brought closer agreement than could previously be obtained.

The forthcoming solar eclipse of 29th May, 1919, will afford an occasion for further testing Einstein's theory. The Sun during totality will be in the constellation Taurus, and if photographed will be obtained surrounded by certain stars to the north of the Hyades group. Now on Einstein's theory light has not only inertia but has weight, that is to say, is subject to gravitational attraction. Accordingly, rays of light coming from stars A and D (see diagram) will be deviated at P' and Q' so that they appear to come from stars situated at A' and D'. These stars will therefore appear to be not merely a solar diameter PQ apart, but at a rather greater separation $P'Q'$, and stars at B and C, which would otherwise be occulted by the intervening Sun will be visible at the Sun's limb. On Einstein's theory a distortion of 1·75 secs. of arc would be expected from stars such as A or D. If no distortion is recorded we shall have the strange result of light possessing mass but not weight, while a distortion of say 0·8 seconds would upset Einstein's theory but would show that light was subject to gravity Davidson and Cortie will observe the eclipse from Sobral in Brazil, while Cottingham and Eddington will be stationed on Principe Island off West Africa. The probable meteorological conditions are not too favourable, and at the best some time will elapse before the photographic plates have been fully measured and compared with others of the same stars taken when the sun has moved away

from the group. The results will be awaited with great interest by all scientists.



[Note added 9th September, 1919.—Reports to hand indicate that the eclipse was observed under fairly favourable conditions. The astronomers are, however, waiting on to obtain photographs of the same stars after the sun has moved away from these stars. By thus having the two sets of photographs taken with the same instruments in the same positions, possible instrumental errors will be reduced to the lowest minimum.]

[Note added 17th January, 1920.—At the joint meeting of the Royal and Royal Astronomical Societies held in London on 6th November, 1919, the Astronomer-Royal (Sir Frank W. Dyson) announced that the eclipse observations supported Professor Einstein's hypothesis. One of the Sobral cameras and that used at Principe —both of which produced sharp photographs—gave about 1.8 seconds of arc as the distortion of rays of light at the sun's edge. The second Sobral camera, despite its unsatisfactory performance, indicated a distortion greater than 0.8 seconds. The only other practical test of Einstein's theory which has been suggested, but not yet confirmed, is a displacement of spectral lines towards the red in the spectrum of a luminous body of great gravitative power.]

HISINGERITE.

By Edward S. Simpson, D.Sc., B.E., F.C.S.

Two hydrous silicates of ferric iron are known in nature—Nontronite and Hisingerite. Of these, the former has been recorded from many different parts of the State including Westonia,* but the latter, which is a much less common mineral, has not previously been observed. In fact, Anderson's *Bibliography of Australian Mineralogy* shows that up till 1916, at least, it had not been recorded from any part of the Commonwealth.

Recently, through the courtesy of H. G. Stokes, Esq., of Westonia, and A. Montgomery, Esq., State Mining Engineer, I have received specimens of hisingerite from that centre. Mr. N. S. Stuckey, Mine Manager, says that the chief occurence is at the 740ft. level of the Edna May Deeps Gold Mine along a joint plane cutting the quartz reef at right angles to its strike. The upper water level is at a depth of only 75ft. and although the main rock masses (granodiorite gneiss and amphibolite) are quite unweathered at 740ft., distinct evidences of weathering are apparent along this joint plane. The occurrence of hisingerite considerably below the surface at a position of incipient weathering coincides with the occurrence of nontronite prevailing throughout the Western Australian Goldfields.

The mineral at the 740ft. level is found in small masses and lenses associated with vein quartz, siderite, a little pyrite, and some indefinite products of rock weathering, possibly including saponite. The creamy white siderite is found not only in small masses in contact with the hisingerite but also, to a slight extent, scattered in granules through it. Two other small specimens from the 676ft. level of the same mine show small crusts of hisingerite and siderite: in one case coating massive pyrrhotite, in the other coating massive and crystallised marcasite with quartz. It is possible, therefore, that the silicate is a replacement of the carbonate, dilute sulphuric acid from the oxidation of the sulphide serving to upset the equilibrium originally prevailing. No evidence is available on which to form a definite explanation of the origin of the hisingerite. Tentatively I would suggest—

$$2FeCO_3 + O + 2(SiO_2 \cdot 3H_2O) = (Fe_2O_3 \cdot 2SiO_2 \cdot 2H_2O + 2H_2O) + 2H_2CO_3.$$

In this reaction dilute sulphuric acid acts as a catalyst, the precipitation taking place in an almost neutral solution.

The mineral is typical in appearance. It is apparently amorphous,† dense and structureless, with a conchoidal fracture and res-

* E. S. Simpson: The Minerals of Westonia. G.S.W.A. Bull. 71, p 243 (1917).
† Sustschinskey's microscopic study of various specimens of hisingerite showed that they were cryptocrystalline. Zeit. Kryst. 47, 231 (1909).

inous lustre. It is opaque (1mm.) with a brownish black colour. Under the microscope the fine powder is translucent and reddish-brown in colour. Most of the fragments are isotropic, but some are strongly birefringent, indicating the association of a small amount of cryptocrystalline matter with a colloid. The masses are very brittle and are penetrated in every direction by minute cracks, probably shrinkage cracks due to dehydration. The density given by Dana is 2.5 to 3.0, but a careful determination of the density of the Westonia mineral gave for four small (2 to 4mm.) fragments, 2.26, 2.26, 2.27, 2.28: the mean being 2.27. These determinations were made by diluting methylene iodide, using quartz (2.65), selenite (2.32) and opal (2.10) as indicators.

The chemical composition sheds light on this low density. Some apparently almost clean mineral was taken for a rough analysis. This was found to be rapidly decomposed by cold 5E hydrochloric acid, the iron going into solution and gelatinous silicic acid, in the form of the original mineral fragments, remaining. Treatment in this way revealed embedded granules of siderite amounting approximately to five per cent. of the whole. The analytical results obtained were—

Fe_2O_3	.. ..	36.8 per cent.
SiO_2	.. ..	31.6 "
H_2O above 100°		6.0 "
H_2O at 100°	..	21.8 "

Allowing for the siderite these are not unlike Dana's figures,* the ratio of SiO_2 to Fe_2O_3 being approximately 2 to 1, but the water is distinctly higher, Dana's average being 21 per cent. The material analysed had been exposed to the air in the author's laboratory for several weeks before analysis, but had not been long out of the mine, and with lapse of time might well have lost more water before reaching a condition of equilibrium in air. The extra water, which is all lost rapidly at 100°, accounts for the low density.

The chemical composition of hisingerite has not been definitely settled. Hintze† does not look upon it as deserving of specific rank. He says—

"Amongst the hydrous amorphous silicates there is scarcely one to be found which can be considered as a 'mineral,' that is, as a chemical compound or isomorphous mixture. . . . .

"A second section of hydrous substances consists essentially of ferric silicate, partly of lighter, mostly green, colour, such as the chloropal of Unghvar in Hungary, partly of brownish black to black colour, such as the hisingerite of Riddarhytten in Sweden: the black as a rule of greasy lustre, dense with conchoidal frac-

* System of Mineralogy, 1896, Ed., p. 702.
† Handbuch der Mineralogie, II., pp. 1827, 1830.

ture. . . . In general these iron silicates are plainly still less homogenous, and on this account still more variable in composition than the aluminium silicates."

Fnrther, he quotes Knop as holding that some of these supposed iron silicates are only mixtures of iron hydrate with quartz or opal.

Dana on the other hand,‡ without being able to ascribe to hisingerite a definite formula, accords it full specific rank, as also does Lacroix.§ This attitude is amply justified by the closely concordant ratios existing between Fe_2O_3, SiO_2, H_2O+ and H_2O- in specimens from widely separated localities.

E. Weinschenk many years ago suggested‖ that nontronite is the homologue of kaolinite, its true formula being

$$Fe_2O_3{\cdot}2SiO_2{\cdot}2H_2O.$$

Chloropal is then a mixture of nontronite with more or less opal.

Reviewing the analyses and chemical and physical properties of hisingerite it appears to the author that this mineral is a distinct species, the homologue of halloysite. Its formula then is—

$$Fe_2O_3{\cdot}2SiO_2{\cdot}2H_2O + 2H_2O,$$

with which further absorbed water is associated at times, *e.g.*, in the Westonia mineral. This formula requires

Fe_2O_3	45·4	per cent.
SiO_2	34·2	„
H_2O+	10·2	„
H_2O-	10·2	„

‡ Loc. cit.
§ Miner. de la France I., p. 405.
‖ Zeit. Kryst. 28, 150 (1897).

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By Authority: Fred. Wm. Simpson, Government Printer, Perth.